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Report of the Dominion Entomologist

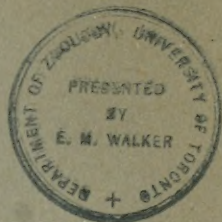
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AUTHOR'S EDITION
FROM ANNUAL REPORT ON EXPERIMENTAL FARMS FOR THE YEAR 1909-10

CANADA



DEPARTMENT OF AGRICULTURE

REPORT OF THE DOMINION ENTOMOLOGIST

C. GORDON HEWITT, D.Sc.

FOR THE
YEAR ENDING MARCH 31
1910

OTTAWA
GOVERNMENT PRINTING BUREAU
1911

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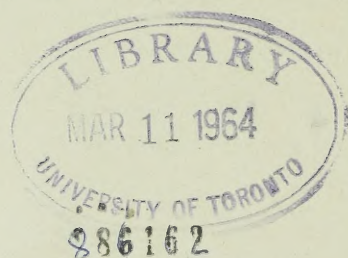
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REPORT OF THE ENTOMOLOGIST

C. GORDON HEWITT, D.Sc.

OTTAWA, March 31, 1910.

Dr. WILLIAM SAUNDERS, C.M.G.,
Director of the Dominion Experimental Farms,
Ottawa.

SIR,—I have the honour to submit herewith the report of the work of the Division of Entomology, with an account of some of the more important insects and pests that occurred in Canada, and concerning which advice was given during the year ending March 31, 1910.

The year has been one of importance and interest for these reasons: it is twenty-five years since my predecessor, the late Dr. James Fletcher, was appointed Dominion Entomologist to the Department of Agriculture, and two years later he was permanently and officially attached to the Department on the establishment of the Experimental Farms in 1887. Owing to the rapid agricultural progress and activity and his indefatigable energy, the entomological and botanical work together became far too great for the direction of a single officer. The need for further development of entomological work and investigation, and the increasing demands for advice, in addition to the increase of other duties of an administrative and executive character, necessitated the separation of the entomological and botanical work and the formation of a separate Division of Entomology. This change was effected during the present year, and, having been appointed in May to take charge of the work, I arrived in Canada on September 16, 1909. The major portion of my time during the ensuing six months has been occupied in the equipping and organizing of the work of the new Division. Three rooms have been provided, and the two larger of these have been furnished and equipped as entomological laboratory and museum respectively, and the third is occupied by me. It has been necessary to make use of a fourth room for the carrying on of breeding and other experiments, and there is a pressing need for accommodation for this work which is the most important branch of the work of the Division.

In equipping the Division, the primary object has been to provide facilities and means for the prosecution of investigatory work. The need of such work is urgent, as we are being confronted annually with fresh problems which can be elucidated only by the careful study of, not only the life-histories of insects, but also their bionomics. In Canada especially, with its varying climates, as complete a knowledge as possible of the factors affecting the lives and habits of injurious insects is a *sine qua non*. We need to know the effect of extreme cold, for example, on certain species of insects in order to be able to determine the possible distribution of such insects. A further field of investigation to which attention must be given is that of parasitism. The importance of a more thorough knowledge of the parasites affecting, not only injurious insects, but also native insects is being realized by entomologists. In many instances we are compelled to rely on such natural means of control as these parasites, belonging to different classes of insects, and also on parasitic fungi. In the work of con-

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trolling the Gipsy and Brown-tail moths in the New England States, upon which more than a million dollars is being spent annually and to which the State of Massachusetts is devoting more than one-tenth of its annual budget, the chief means by which control will ultimately be established will be undoubtedly by parasites, and upon the study, importation, breeding and distribution of the different parasites of these two insects, several hundred thousand dollars are being expended each year—indicating from a monetary point of view alone the importance of this means of control. A knowledge of the relation of birds to the agriculturist and horticulturist, as regards their utility and otherwise as natural means of control of insect pests, is greatly to be desired. Owing to the absence of any accurate data of value on this subject in Canada there is a danger of the destruction, through ignorance, of species which may be useful to the farmer and fruit grower and, until such data have been collected by actual analysis of the contents of the stomachs of birds, no statements of value can be made as to the economic worth of any but purely insectivorous birds.

The work of the Division at present falls under a number of heads. The greater portion of the time of the officers is occupied in the identification of injurious and other insects sent in by correspondents in the various provinces of the Dominion, and the giving of advice as to the treatment of these pests. Whenever it is necessary or desirable the insects are studied. In addition to these investigations that are continually being made, it is intended to make a study of certain problems which are at present requiring attention. The Brown-tail Moth (*Euproctis chrysorrhæa*, L) will be studied in reference to conditions in Canada. A study of the Larch Sawfly (*Nematus erichsonii*, Hartig.), which I began in England, is being continued with especial reference to its European and American parasites. Mr. Gibson is continuing his work on the larvæ of the Noctuid moths, many of which, under the popular name of 'cut-worms,' are responsible for enormous losses at times; consequently a study of the life-history and bionomics of all the forms that it is possible to obtain is of very great importance, as the possession of such knowledge is oftentimes of value, inasmuch as it not infrequently happens that, when land is cultivated, species hitherto uninjurious become pests. Further experiments on the control of those injurious insects, the Root-Maggots, will be carried out. A number of other important lines of investigation, many of which are urgent, will be followed as opportunities are offered.

During the past few months a new 'Destructive Insect and Pest' Bill has been introduced. The necessity for such legislation is extremely pressing. With the rapid development of all forms of rural activity, and the importation of vegetation of all kinds from other countries, we are exposed to the grave danger of the introduction of serious insect and other pests. As examples of such introduced pests it is only necessary to refer to the San José Scale and the Brown-tail Moth, than which no more serious fruit pests occur. There was already in existence the San José Scale Act passed in 1898, with subsequent amendments, under which regulations were made for the fumigation of all nursery stock likely to be infested with the scale, and the fumigation stations at six ports of entry were established. Such regulations, providing for fumigation only, were totally inadequate to meet the requirements of present conditions, and in view of this the Hon. the Minister of Agriculture introduced the new Bill. Briefly, it provides for fumigation against the San José Scale and Woolly Aphis; the inspection of imported nursery and other stock that is liable to be infected with serious insect pests such as the Brown-tail and Gipsy Moths, and the power of inspection of orchards and other lands or premises which it may be deemed advisable to inspect for those insects and other pests scheduled as serious. On the appearance or threatened appearance of an insect pest dangerous to agriculture, horticulture or forestry, it will be possible for the Hon. the Minister of Agriculture to issue such regulations as shall enable him to take the necessary precautionary or eradivative steps. It also makes provisions for the granting of compensation by the Minister for vegetation, &c., destroyed in pursuance of the regulations.

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The Brown-tail Moth is still the most serious entomological problem with which we have to deal. Towards the end of March I visited those districts in Nova Scotia where the insect has been established and exists at present, to gain a complete idea of the nature of the infestation. During this visit, I addressed several public meetings in the infested region and impressed the seriousness of the infestation upon the people, many of whom, owing to their ignorance as to the facts, which was only natural, had been somewhat indifferent. With the means at their disposal, the provincial authorities under Mr. M. Cummings, the Secretary of Agriculture for Nova Scotia, have carried on an excellent campaign against the insect and too much stress cannot be laid on the importance of such eradivative measures in the early stages of the infestation. In our campaign against the Brown-tail Moth we may profit by the painful experience of the State of Massachusetts. In 1890, they began exterminative work against the Gipsy Moth which had increased enormously since its introduction in 1869 and was inflicting most serious damage in the State. This work was energetically continued for ten years and by 1900 the moth had been reduced to such an extent that it was doing no serious damage and, in fact, had been exterminated in many localities. Most unfortunately, the State discontinued operations and in a few years the insect increased to such an enormous extent and spread over so wide a territory, that now, with the Brown-tail Moth, it is entailing an expenditure of over a million dollars annually. It is necessary, therefore, that every means possible should be taken to prevent the spread and obtain control of this insect in Canada or it will be impossible to estimate the financial loss and physical suffering which its presence will entail. This season the inspection of European nursery stock imported into Canada is being continued and already a large number of the winter nests of the Brown-tail Moth have been discovered on French nursery stock, but, as the inspection will continue until May, the results cannot be given in this report.

I am pleased to say that there have been no serious outbreaks of insects injurious to cereals which form the staple results of agricultural activity in Canada. White Grubs and Wireworms have caused serious damage to potato crops in certain regions and methods of combatting these are considered below. A slight spreading of the San José Scale has occurred, but it is believed and hoped that the means that the Department of Agriculture of Ontario are adopting for dealing with this insect will be effectual.

In July, a serious outbreak of the Spruce Budworm (*Tortrix fumiferana* Clemens) was investigated and reported upon by Mr. Gibson. Certain species of bark and timber boring beetles are causing much damage, especially to coniferous forest trees, and it is extremely desirable that a knowledge of these should be gained, especially on account of its important relation to the question of the conservation of our forests.

In addition to the above work, great use is made of the Division by entomologists and collectors in different parts of Canada who send in specimens and collections for identification. By means of our own collections and with the help of specialists in Canada and the United States, for whose assistance I wish to express my sincere thanks, especially to Dr. Howard, Entomologist to the United States Department of Agriculture, we are able, not only to render this useful assistance, but also to acquire knowledge which is frequently of importance to the work of the Division. The entomological collections of the Division are being arranged with a view to making them as useful as possible to the student, the teacher and also the general public. For the general public and for lecturing purposes, exhibits of typically injurious insects, their life histories and injuries are being arranged. In the absence of a national collection of Canadian insects, every endeavour is being made to render the systematic collections as complete and representative as possible.

The supervision of the orchards on the Indian reserves in British Columbia, on behalf of the Department of Indian Affairs, with a view to the eradication of the

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pests occurring there, has continued, and the work of spraying, pruning and cleaning cut has been carried on by Mr. Tom Wilson. It is a great pleasure to find that our efforts to inculcate better horticultural methods among the Indians are not only meeting with some success, but are also giving satisfaction to the fruit-growers and settlers who previously complained about the state of the Indian orchards.

Shortly after taking up my duties, I left Ottawa on October 3 for British Columbia to inspect the western fumigation stations and the Indian orchards, and also for the purpose of inquiry in connection with the work of the Division. The Experimental Farms at Brandon, Indian Head and Agassiz were visited, and I returned on October 26. The annual meeting of the Entomological Society of Ontario at which I delivered the public address, was attended in November, and from this meeting I went to Niagara Falls and Windsor, Ont., to inspect the fumigation stations at these points. The fumigation stations at St. John, N.B., and St. John's, Que., were inspected on November 18 and 19. On December 9 an address on 'Fruit Pests' was delivered at the annual meeting of the Pomological Society of Quebec at Macdonald College, Que. The meeting of the American Association for the Advancement of Science held at Boston during the last week of December was attended, including the meetings of the Entomological Society of America and the Association of Economic Entomologists, a paper on the Larch Sawfly being read at the latter. Addresses have also been delivered before the Commission of Conservation and also at Truro, N.S., and other places on various classes of injurious insects and their control.

I should like to take this opportunity of acknowledging the services of, and my indebtedness to, my Chief Assistant, Mr. Arthur Gibson, who carried on the work of the Division from the beginning of the year until my arrival in September, that is, for the first six months and also during my absence from Ottawa at various times. Mr. R. C. Treherne, B.S.A., is inspecting European nursery stock for the Brown-tail Moth, and Mr. J. A. Letourneau, in addition to the secretarial work which he has efficiently carried out, has begun a catalogue of the entomological publications of the library of the Division, which has been considerably increased by the purchase of the library of the late Dr. Fletcher and of a number of standard works and additional periodicals.

The work of the Division is increasing annually, but especially during the last year, owing to the measures that are being taken against the Brown-tail Moth. It is of the greatest importance, however, that the more important work of investigation should not be hindered owing to the natural increase of duties of an executive character, otherwise progress in our knowledge of the problems awaiting solution will not be made, and the work of the Division cannot attain such a scientific character as is essential, if it is to be of the greatest practical value to Canada.

I have the honour to be, sir,

Your obedient servant,

C. GORDON HEWITT,

Dominion Entomologist.

DIVISION OF ENTOMOLOGY.

Every year complaints are made concerning the injuries to field and root crops caused chiefly by two species of insects, namely, White Grubs and Wireworms. In many cases these injuries might have been prevented or reduced had the farmers and others been in possession of the following facts. White Grubs and Wireworms generally occur in old pasture or grass land. Their presence is not usually noticed unless their injuries are severe, as in the cases mentioned later. This is doubtless owing to the fact that grass land does not receive so careful scrutiny as a crop. When such land is turned down and put under cultivation, the subsequent crop is usually sown at once; not infrequently potatoes are planted, with the result that these insects, supplied with new food very much to their liking, cause considerable damage. It is necessary, therefore, for farmers to bear these facts in mind and, on putting old grass or pasture land under cultivation, to adopt such means of cultivation as are recommended in order to avoid the possibility of serious injuries to their crops by these insects, which, owing to their peculiar life histories and habits, cannot be controlled on a large scale by other means. It will be found that where a regular rotation of crops is practised and land is not left under grass for more than two or three years, White Grubs and Wireworms will be considerably less injurious, and from the point of view of crop production, such rotations are to be recommended.

During the year the White Grub has been one of the most injurious insects. This insect has been extremely plentiful, especially in the eastern provinces of the Dominion, and in every occurrence it was reported to be very injurious. In many counties in Ontario and also in Quebec and Prince Edward Island, potatoes were severely attacked; in some cases they were not worth digging and 12 to 15 grubs were to be found in a single hill. In Middlesex, Ont., grass-land was so severely attacked that the top could be rolled off perfectly dead, and one correspondent collected four quarts of the grubs, which were only about one-third of those present, in a tenth of an acre. In Ontario, Quebec and Nova Scotia they were injurious to strawberries and to corn which had been planted on the sod in Ontario.

The White Grub is the larva of a fairly large and robust brown beetle which, as it appears in these regions in June, is called the June Bug; further south they appear earlier and are known as May Beetles. These beetles, usually species of *Lachnosterna*, feed on the foliage of certain trees such as oak, maple, poplar, chestnut, &c., and are sometimes the cause of no little injury to such hardwoods. They deposit their eggs singly in the ground at a depth of one to several inches and the young white grubs or larvæ on hatching out feed on the young roots of the grass or crop which they are attacking. The approach of winter causes them to work their way deeper into the soil where they hibernate. They usually remain three seasons in the grub stage, hibernating each winter except the last, before which the grubs usually change into the pupal stage, and from this into beetles, and the mature beetles hibernate to emerge the following year. The greatest damage is done by the grubs in the second and third years of their growth when they feed on the larger roots. It should be pointed out, however, that our knowledge of these insects and their life histories is comparatively meagre. The remedial treatment are still, as a rule, in the unsatisfactory state of being suggestive.

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DIAGRAM OF LIFE HISTORY OF THE WHITE GRUB. (*Lechnosterna* sp.)

1910.		1911.		1912.		1913.
Summer.	Winter.	Summer.	Winter.	Summer.	Winter.	Summer.
Eggs laid, Grubshatch and begin to feed.	Grubs hibernated.	Grubs feed.	Grubs hibernated.	Grubs feed and change into Pupæ, from which Beetles emerge in a few weeks.	Beetles hibernated.	Beetles emerge and lay eggs.

As the White Grub passes all its life underground it is almost impossible to control it by ordinary measures. In cases where small areas of grass are attacked, drenching the affected area with kerosene emulsion is sometimes effective. Where larger areas are attacked, methods of cultivation only can be relied upon. Deep ploughing in the fall will bring up large numbers of the hibernating grubs and expose them to climatic influences such as frost, &c. If possible, this should be repeated a second year and cross-ploughing is to be recommended if the infestation is severe. Hogs or poultry turned on the ploughed land will destroy large numbers of the grubs. Such crops as cereals and roots should not be sown on infested land, but clover, which appears to be more immune, may be sown on the land and then ploughed under in the following fall. Two fall-ploughings with an intermediate crop of clover will expose and destroy very many of the White Grubs in their different stages. It is impossible on account of the prolonged life history, extending as it does over several years, to rid infested land of these insects by measures carried out for one year only; repetition is necessary to destroy those larvæ which have escaped the previous year's treatment. In Europe, the destruction of the adult beetles, which can be effected by collecting them or by spraying the infested trees with an arsenical spray has been found to be of great service in reducing the infestations.

WIREWORMS.

As in the case of White Grubs, these insects are found frequently to attack crops of cereals or roots which have been sown in permanent grass land newly turned under cultivation, owing to the fact that their normal habitat is grass land, where they live feeding on the roots. Potatoes are often sown as the first crop, and, in consequence, the majority of complaints that are received are of injuries to potatoes in the different provinces from Nova Scotia to British Columbia. In Ontario, it was the chief insect of which complaints were received as destroying new fall wheat, and in Nova Scotia it destroyed corn which had grown about two feet in height.

Many remedies have been suggested for Wireworms and much disappointment has resulted from their trial, with no little loss of time, money and faith. The wireworm is the larva of a beetle known as the 'click-beetle,' of which there are a number of species. The beetle is rather long compared with its breadth, brown in colour and has the habit, when laid on its back, of jumping into the air with a click and righting itself. The Wireworms are about an inch or an inch and a quarter long when full grown, of a light brown or brownish yellow colour and have three pair of legs at the anterior end. These characters distinguish them from the millipedes mentioned later, which are often mistakenly called Wireworms. Their life history, like that of the White Grub, is a lengthy one and the 'worm' or larval stage may last

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two, three or four seasons according to the species of Wireworm and also according to conditions of climate and soil. After its lengthy life, the 'worm' changes into the pupa at the end of the summer and in two or four weeks the pupa changes into the adult beetle which hibernates until the following spring when it emerges to lay its eggs. At Ottawa, adults were seen flying on sunny mornings of the last week in April. It is customary, therefore, to find Wireworms of different ages in the soil, and these pass the winter in this situation. Consequently, the best method of treatment, as in the case of the White Grub, is one of cultivation, and the greatest benefit can be obtained by adopting the same measures, namely, deep ploughing in the fall to expose the larvæ and pupæ. Clover or buckwheat may be sown on grass land which has been turned down to cultivation if it is not desired to leave the land under summer-fallow which is the procedure to be most recommended; but a clean fallow is not always successful. On account of the hard and resistant nature of the Wireworm and its position during life it is almost impossible to treat it with insecticidal substances and these are not to be recommended. Penning sheep on grass land intended for cultivation is sometimes attended with good results as the sheep tread the soil down firmly and prevent the movement of the Wireworms, and by heavily manuring the land, make it unattractive to the beetles. It has been frequently recommended to dip the seeds or grain in certain preparations or chemicals before planting in order to prevent the attacks of Wireworms. Careful investigations into these methods and remedies have shown that, as a rule, they are useless, and to adopt such methods is a waste of time and money. It is evident that the fact of the grain being coated with a poisonous substance will not prevent the Wireworm from eating the young roots, which are of course not poisoned, as is its custom, and thus killing the young plant.

ROOT MAGGOTS.

From year to year, the attacks of these insects appear to assume greater proportions and from all provinces the injuries of the different species to roots and other field and garden crops are reported, many of these reports indicating the serious nature of the injuries, and the aggregate loss due to these insects alone must be very great. In the vicinity of Edmonton it is said to be extremely difficult to grow onions on account of the Onion Maggot (*Phorbia ceparum* Meig.). In the same district the Cabbage Root Maggot (*P. brassicæ* Bouché) destroyed early cabbages and cauliflowers. One correspondent planted about 2,000 late cabbages and large numbers of the eggs were seen round the stems of nearly all. In Ontario, cabbage, radishes and cauliflowers were attacked. A correspondent at Munro, B.C., had most of his turnips killed when quite young; when the remainder were harvested it was found that the portions of the turnips underground were masses of maggots. These insects have now appeared so far north as the Yukon territory where their presence was unknown a few years ago, but they were reported during the past year as attacking turnips, radishes and onions.

THE CABBAGE ROOT MAGGOT (*Phorbia brassicæ*) and the Onion Maggot (*P. ceparum*) have been responsible for the most of the injuries reported to the Division. The Seed Corn Maggot (*P. fusciceps* Zett.) is not infrequently responsible for serious injuries to Indian corn and beans in Canada.

When studying the breeding habits of an allied species, (*Anthomyia radicum* L.) in England a few years ago, it was found that the female flies were attracted to manure in which they laid their eggs and the larvæ or maggots developed in the manure. This explains a fact which is frequently noticed, namely, that root maggots are more numerous and injurious on land which has either been freshly manured or heavily manured, and the number of instances of the influence of stable manure

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in attracting the flies and serving as additional food for the maggots have come to my notice. The flies into which these maggots develop are somewhat similar in appearance to small house-flies, and they lay their eggs round the bases of the young plants early in the summer, the worst damage being usually experienced in June and July. Vegetables which are planted early withstand the attacks of the maggots better than those planted later, which sometimes appear quite healthy one day and are withered the next. Mr. Fyles states that radishes sown at Quebec in the beginning of May are a success; radishes sown at Ottawa in May are attacked. The development of these insects may be complete in two or three weeks and there are a number of broods during the season, the injuries becoming more serious with the increase in the numbers of the flies. The winter is passed in the brown pupal stage.

As these insects are becoming so seriously troublesome in Canada, it is important that farmers and others should be familiar with those measures by the application of which benefit has been derived in the prevention, control and eradication of the different species of root maggots. It should be remembered that the value of a particular measure depends on a number of natural factors such as locality, climatic conditions, nature of crop, &c., and a remedy which may be effective one year may not give the same results in the following year.

TARRED PAPER CARDS.

The method of control which has proved most successful in the protection of cabbages and cauliflowers from the attacks of the Cabbage Root Maggot, and at the same time very cheap, is Goff's tarred paper card device. The principle of this method is the surrounding of the stem of the transplanted seedling with a tarred paper card which closely encircles the stem of the plant and lies flat on the ground; by this means the female flies are prevented from laying their eggs at the base of the stem of the cabbage or cauliflower. If this method is continued for several years it will be found to be the best protection against the Cabbage Root Maggot. The tarred paper cards are cut out by means of a special tool shown at A in Figure 1. This must be carefully made by a blacksmith, and the cutting blade consists of a half hexagon, from one corner of which the blade passes to the centre and finishes in a star-shaped stud which makes the star-shaped cuts in the centre of the card. The edge of the tarred paper is first cut into the shape shown in Figure C by using one angle of the tool only. The complete cards are now cut out by beginning on the left-hand side and placing the blade of the cutting tool as indicated by the dotted lines; in this way, by tapping the handle of the cutting tool with a mallet, a complete hexagonal disc similar to B is struck off and this process is continued across the paper. In each line there will be a certain portion of the paper left over in cutting the hexagons. When the seedlings are transplanted the cards are placed round their bases by opening the slit and slipping it round the stem which passes through the star-shaped cut in the centre of the card. It is extremely important to place these cards on the plants correctly, as carelessness in fixing them will render them useless. The card should fit tightly round the base of the stem of the plant and should be perfectly flat upon and close to the ground, as shown in Figure D. Figure E shows how the cards should *not* be applied. If the soil is inclined to be rough or lumpy, it should be rolled *before* the planting of the seedlings in order that the cards may lie flat on the ground and fit well round the bases of the seedlings. In practice, this has been found to be the cheapest and most effectual method yet devised. It is not possible to use this method against the root maggots attacking such vegetables as onions, radishes or turnips, and for these the carbolic emulsion may be used, as it has been found effectual and is cheap, although in certain cases it is not infallible; Slingerland's formula is; 1 lb. of hard soap or 1 quart of soft soap dissolved in a gallon of boiling water, a pint of *crude* carbolic acid is then added and the whole is agitated into an emulsion which

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will keep for some time. One part of this is diluted with thirty to fifty parts of water. It should be applied early, when the plants are coming up. The roots of seedlings to be transplanted should be dipped in the emulsion, and then the bases of the plants should be watered well with the emulsion every week or ten days. Watering the plants about once a week with a decoction of hellebore, using two ounces of hellebore to one gallon of water, will give good results in the case of radishes.

Where small plots of cabbages or other vegetables are grown, they may be protected from the Root Maggot flies by covering the plants early in the season with cheese-cloth screening stretched over frames. The lower edges of the cheese cloth should be spread a little on the ground and covered with earth to prevent the flies from creeping under. Some growers might find it economical to prepare frames covered with a weather-resisting, bronze wire fly screen. The injection of carbon bisulphide near the bases of the plants has been found effective in the destruction of the maggots.

Particular attention should be paid to methods of cultivation. Weeds belonging to the same family of plants as the cabbage, namely the Cruciferae, such as wild mustard, &c., should be destroyed; but, in good farming, this applies to all weeds. Deep ploughing in the fall would tend to bury many of the pupae, in which stage the winter is passed, too deep in the soil for the emergence of the fly in the following year.

APHIDES AND SCALE INSECTS.

The season of 1909 was an exceptional one in Canada for the abundance of the different species of aphides or plant lice and also the allied scale insects. This was also the experience in the United States and in England. Our knowledge of the bionomics of these insects is, as yet, insufficient to enable us to explain this abnormal abundance, but observations on the reproduction of aphides suggest a possible explanation. The abundance of aphid life is dependent upon the rate of reproduction of aphides, and this, I have found in a number of cases studied, is dependent on the amount of sap present on the trees or plants upon which they are feeding. A large amount of sap, in other words an abundance of food, encourages growth and reproduction. The amount of sap in most plants is dependent primarily upon the rainfall and such meteorological conditions as the humidity of the atmosphere. A study of the records shows that the rainfall of the spring and summer of 1909 was considerably higher than the normal; the temperature of January, February and March was higher than usual, the winter being favourable for trees, and, notwithstanding a wet and backward spring, the month of June was noticeable for the luxuriant growth of vegetation, the luxuriance of which was maintained by the heavier rainfall of the succeeding months. Such conditions, and the lack of sufficient numbers of parasitic and predaceous enemies may account, I think, for the abnormal abundance of aphides in certain years. The importance of knowing these conditions with certainty is very great, as, when that is accomplished, it will be possible, to a great extent, to predict the abundance or scarcity of aphid life and to act accordingly.

The rapid rate at which aphides are able to reproduce is due to two facts: first, that they are able to reproduce parthenogenetically; that is, an unfertilized female is able to reproduce; secondly, such a female produces living young instead of eggs. These females, therefore, are able to produce large numbers of their kind which in turn are themselves able to reproduce in like manner in the course of a few days.

The different species were very abundant in the early part of the year on herbaceous plants, trees, conifers, cereals, &c. Fruit trees suffered considerably from the Apple Aphis which largely ruined good crops in certain localities; the Plum Aphis and, in British Columbia, the Cherry Aphis, were abundant. The life history of a typical aphid or plant louse is briefly as follows: The winter is passed in the egg stage and

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the eggs may be found often in large numbers on the twigs of the trees, those of the Apple Aphis being shiny, black, oval bodies. In the spring, usually when the buds are opening, the eggs hatch and the minute plant lice make their way into the unfolding leaves where they immediately begin to suck the sap from the tender foliage and soon grow to their full size. These individuals now begin to produce living young ones and this continues from generation to generation during the summer, these generations being wingless. In some species complications are introduced owing to the fact that a winged generation is produced which migrates to a different host plant and there continues the life history of the species; in some cases the egg stage and spring generation is passed on plants of a woody character and the early summer generation migrates to some crop which dies down in the winter. The Hop Aphis (*Phorodon humuli* Schrank) passes the summer on the hop, but winged forms migrate to the plum (including wild plum) in the fall and from these, sexual forms are produced which deposit eggs on the twigs of the plums from which the spring generations are produced. In the fall, this production of living young by virgin females ceases and sexual forms, males and females, are produced which may or may not be winged—the males are usually winged. These sexual and fertilized females deposit the winter eggs. The remedies for aphides are winter spraying with lime washes or lime-sulphur and spring spraying with kerosene emulsion. The method of preparing these insecticides is given under the description of the Oyster-shell Scale. For a summer spray, it is difficult to find a more effective and cheaper spray than the home-made tobacco decoction. The tobacco can be grown and dried at home and an excellent contact spray for aphides is made by soaking for several hours one pound of this tobacco, or two pounds of tobacco stems or dust in four gallons of water which is almost boiling and applying the solution warm. *The water must not be boiled after the tobacco has been immersed*; it should be kept hot but not boiled or the nicotine will begin to volatilize.

THE WOOLLY APHIS OF THE APPLE (*Schizoneura lanigera*, Hausm) appears to be increasing, having been recorded from Ontario and Nova Scotia. Fruit growers should take all measures possible to eradicate this most serious pest which is especially insidious as it attacks the roots of the tree in addition to the branches, and the root form, once established, is difficult to eradicate. The aerial form of the Woolly Aphis may be treated in the same manner as other aphides, but it is necessary to adopt special measures to eradicate the root form. All nursery stock should be most carefully fumigated or dipped in kerosene emulsion before being planted; this will prevent its introduction on nursery stock, which is a common means of distribution. If the branches or twigs are attacked by Woolly Aphis, it is very probable that the root form occurs also and treatment should be adopted accordingly. Remove the soil to a depth of four to six inches round the base of the tree to a distance of about two feet from the crown, the ground and roots should now be drenched with a strong solution of kerosene emulsion or with a strong decoction of tobacco. The use of dry tobacco ash has also been found effectual. Another method may be used if the soil is dry and not too heavy; namely, the injection of carbon bisulphide into the ground about 18 inches from the crown of the tree, taking care not to touch the roots. This liquid volatilizes and the gas, which is poisonous to insect life, percolates through the soil.

In certain cities, such as Toronto and Quebec, the elms have been attacked by the Woolly Elm Bark Aphis (*Schizoneura rileyi* Thomas).

The Woolly Aphis of the Alder (*Pemphigus tessellata* Fitch) was very common and specimens collected near Ottawa in September were being preyed upon by the caterpillar of the little orange butterfly called 'The Wanderer' (*Feniseca tarquinius* Fabr.).

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THE OYSTER-SHELL SCALE (*Lepidosaphes ulmi* Linn.) or, as it is sometimes wrongly called the Oyster-shell Bark Louse, which name rightly belongs to another scale insect (*Aspidiotus ostreaformis* Curtis), is increasing in most of the provinces; in Ontario it has become a serious pest and appears to be doing as much damage as the San José Scale and Codling Moth as it occurs in almost every orchard. This increase is due largely to neglect on the part of many fruit growers who own but a few, usually old, trees which are not infrequently covered with scale. During the winter the scale, which resembles somewhat the shape of a blue-point oyster, acts as a protective covering for the yellowish-white egg, which may number as many as 80 under a single scale. The eggs hatch in May and June and the young six-legged larvæ creep out and seek a fresh site where they soon settle down and form a protective scale under which they live, feeding on the sap of the tree and, after laying their eggs at the end of the summer, they die. Most of the individuals are females and these are wingless; the males are winged and rare. The following methods of eradication may be employed:—

1. The trees should be sprayed shortly before the buds open in the spring with either a simple lime-wash (using about $1\frac{1}{2}$ pounds of lime to a gallon of water), or lime-sulphur. The lime-wash is effective partly owing to its caustic action and partly by preventing the emergence of the young larvæ. As in all such spraying, the whole of the tree including the ends of the twigs should be well covered with the spray solution. The home-boiled lime-sulphur wash is preferable to the commercial lime-sulphur for this spring spraying of dormant trees and is made in the following manner:—

Unslaked lump lime, 20 lbs.; sulphur, 15 lbs.; water 45 gallons. Slake the lime with warm water and while it is boiling hot add the sulphur and stir thoroughly. The whole is now boiled steadily over a fire, or by means of steam, adding more water when necessary until the mixture is of a deep reddish brown colour. Sufficient water should be added to make it up to 45 gallons and after a few minutes further boiling the solution should be strained and applied as warm as possible. If it crystallizes, it will be necessary to reboil. Very badly infested trees should have an extra spraying in the fall. If the trees are thoroughly and regularly sprayed each year with lime or lime-sulphur, this and other scales will be eradicated and the trees will be kept clean.

2. A careful watch should be kept for the emergence of the young larvæ and as soon as they appear, as yellowish white specks crawling about on the bark, the trees should be sprayed with kerosene emulsion. Kerosene emulsion is made as follows:—

Kerosene (coal oil), 2 gallons; whale-oil soap, $\frac{1}{2}$ lb.; soft water, 1 gallon. Dissolve the soap by boiling in water. While the solution is boiling hot, take it away from the fire and pour it into the kerosene. The solution is now violently churned and agitated for about 5 minutes to form an emulsion. This is the stock solution, and, if well made, will keep. In the summer, use it in the proportion of one part to 10 or 12 parts of water. For winter use and for the root form of Woolly Aphis, a stronger solution is made by adding eleven gallons of water to this stock solution. Whale-oil soap, using one pound of whale-oil soap to five gallons of water, may be used instead of kerosene emulsion. Commercial lime-sulphur used in the proportion of one part in 30 parts of water has also been found useful.

THE SAN JOSÉ SCALE (*Aspidiotus perniciosus*, Comst.). During the past year, this insect has spread slightly; cases were reported from York and Prince Edward counties, Ontario, and a single case from Zephyr, Ontario. The latter case was eradicated and the other cases were due to the transference of infected stock from the infected regions in the province. No further cases of the introduction of this insect have been reported from the other provinces of the Dominion, which attests to the efficacy of the fumigation stations. Although the appearance of this scale is not yet familiar to all fruit growers, the methods of eradica-

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tion are too well known to necessitate their repetition. The system of winter spraying with lime-sulphur in its several forms, home-made, commercial and self-boiled, has now become so necessary an operation in the cultural systems of the successful and progressive fruit grower that, with its universal adoption, it is not too much to predict the control of this and other scales. Wherever it has been regularly used each year, the scale has been controlled and far better crops of fruit have been produced. The indifferent fruit growers are the greatest obstacles to the attainment of such conditions of control and we must rely on legislation and neighbourly influence to overcome the greatest of obstacles to all progress—indifference.

THE TERRAPIN SCALE (*Eulecanium nigrofasciatum* Perg.) was injurious to ornamental maple trees in the southern part of Ontario. It was destructive at Hamilton, Chatham and Humberstone, Ont., but it is a hopeful sign that large proportions of the scales were parasitized.

THE BROWN-TAIL MOTH (*Euproctis chrysorrhæa* L.).

Nova Scotia is still the only province in which this serious pest is known to have established itself, and, since its discovery in that province in 1907, the Provincial Department of Agriculture have carried on annually a most active campaign in the endeavour to obtain control of this insect. Principal Cumming, Secretary of Agriculture, Nova Scotia; Prof. Smith, of the Agricultural College, Truro, and Mr. Vroom, of the Fruit Division of the Dominion Department of Agriculture, have all worked assiduously to attain this end. In the spring of 1907, when the presence of the insect was discovered, over 6,000 nests were destroyed and in the following year about 4,000 nests were known to have been destroyed; these numbers probably represent more than actual nests of the Brown-tail Moth owing to the bounty system which was in vogue as an emergency expedient and under which mistakes might easily be made. In 1909, a careful inspection resulted in the destruction of over 800 nests and during the present winter a large number have been found up to the time of writing. Notwithstanding the increase of the number of nests, it is satisfactory to find as a result of a personal visit and the evidence of Prof. Smith and others, that no nests could have occurred in the districts west of Digby. The most seriously infested localities lie in the district between Smith's Corner, Digby county, on the west and Middleton and Nictaux, Annapolis county, on the east, a district between 40 and 50 miles in extent. With the exception of Nictaux, the western part of this region, including such localities as Bear River and Deep Brook, is the most seriously infested. This region is being thoroughly worked over by Messrs. Payne and Brown of the Provincial Department of Agriculture, and also by Mr. Vroom. In New Brunswick, where there is still greater danger of invasion by this insect, only a few specimens of males have been found. A considerable number of cocoons of the Emperor Moth (*Samia cecropia* L.) have been sent to the Division in the fear that they were nests of the Brown-tail Moth. The Department of Agriculture of New Brunswick commissioned Mr. William McIntosh, an observant entomologist, to traverse the country likely to be infested and also to distribute literature and advice in the schools. Up to the present, no signs of the insect having established itself in that province have been discovered. To prevent the introduction of the insect in the form of winter nests on nursery stock imported from Europe, this stock was carefully inspected at the points of destination by our own officers, Mr. Gibson and Mr. Treherne who acted as special inspector. The following letter was sent to all the Canadian nurserymen on our list and the agricultural papers in the different provinces:—

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DIVISION OF ENTOMOLOGY,

CENTRAL EXPERIMENTAL FARM, OTTAWA,

January 5, 1910.

To Nurserymen and others:—

We are again confronted with the possible introduction of the Brown-tail Moth into the Dominion in the shape of the winter nests on nursery stock imported from abroad, especially from certain regions in France where nursery stock has been growing in fields bounded by hedges infested with the Brown-tail Moth.

Last year nurserymen and other importers co-operated with this Division in the work of preventing the introduction of this insect by advising us of the arrival and expected arrival of consignments of nursery stock from abroad. This enabled the Division to inspect the stock and to destroy any of the winter nests that were found. Over a million and a half plants were examined and nearly two hundred nests were found on seedlings and stocks of pear, apple, plum, quince, cherry, rose, spiræa, &c. In view of the fact that each nest may contain from 200 to 300 larvæ of this insect, the great benefit to fruit growers, horticulturists and others resulting from the work of last season can readily be understood. In the eastern States thousands of dollars are being spent annually by the various authorities in their efforts to control and prevent the spread of this insect, which has established itself in those regions since its introduction into Massachusetts on imported stock about the year 1890. It is of the utmost importance that all steps possible shall be taken to prevent its introduction and establishment in those regions of Canada now free from its attack, and its further spreading in those places in Nova Scotia and New Brunswick where it has been introduced accidentally. Its establishment in Canada would be most serious to the nurserymen and fruit growers of this country, and every precaution possible must be taken to avert such a calamity.

Will you kindly inform me, therefore, if you are importing or have already imported nursery stock this season from abroad, and the place from which the stock is being or has been imported.

As nests have been found on stock imported during the present season, I should be pleased if you would send me this information at once in order that your stock may be inspected, if necessary. If the stock has not arrived already, would you please send me notice as to the time of its arrival in order that it may be inspected at the time of unpacking, and thus the least inconvenience will be caused.

It has been found that fumigation is of no avail against this insect, and that destruction by burning of the winter nests is the only safe remedy.

I feel sure that all to whom this letter is addressed will be alive to the seriousness of the danger which is imminent, and will co-operate with the Division and other authorities in the efforts being taken to prevent the introduction and spread of the Brown-tail Moth. I shall be pleased to supply further information or reply to communications on the subject, and shall be grateful for any assistance which you are able to give me.

I have the honour to be, sir,

Your obedient servant,

C. GORDON HEWITT,

Dominion Entomologist.

The Department of Agriculture of Ontario willingly co-operated and gave us the assistance of an inspector. Through the courtesy of the importing nurserymen, every case of nursery stock is being carefully inspected. It is a pleasure to acknowledge the assistance of Dr. L. O. Howard, Entomologist and Chief of the Bureau of

Entomology of the United States Department of Agriculture, who has notified us of a large number of shipments of European nursery stock passing through the United States *en route* for Canada, and also the assistance of Mr. Geo. G. Atwood of the New York State Department of Agriculture, who also sent notifications. These notifications assisted us in making arrangements for the inspection of the stock, and we were also notified of the arrival of nursery stock by the Collector of Customs at the different ports of entry by arrangement with the Department of Customs. In British Columbia the inspection was left in the hands of the Department of Agriculture for that province, and Mr. T. Cunningham, the Provincial Inspector of Fruit Pests, has assured us of the extra care that is being taken in the inspection of European stock.

This inspection is resulting in the finding of several hundreds of the winter nests on imported stock. The results of last season's inspection, which was concluded in May of the present fiscal year, were given in the last annual report; but as the inspection in Nova Scotia, in Ontario and in British Columbia is not yet concluded, the results must necessarily be deferred until the next year's report. The results of this season's inspection so far indicates that a greater number of nests are being discovered on European stock and a larger amount is being examined. Under the new Destructive Insect and Pest Bill* now before Parliament, it will be possible to inspect all European and other nursery stock likely to be infected with the winter nests of the Brown-tail Moth upon its arrival in Canada, and also to inspect orchards and other premises upon which it may occur. The greatest danger is the indifference on the part of the public and the failure to realize the serious importance of this pest which is entailing an annual expenditure of over a million dollars in the New England States. Its presence in the form of the winter nests or webs is easily discovered and its destruction is still more easy. The simplest means of eradication is the cutting off and burning of the winter nests, which may contain from a few dozen to as many as two thousand caterpillars; the usual number being about two or three hundred in a nest of average size. During the five winter months, when the leaves are off the trees, these nests are readily seen and it is during this period that a careful search should be made of orchards likely to be infested, and such adjacent trees as wild thorn and apple. The nests have also been found on oak, maple and elm in Nova Scotia, and the danger of the insect establishing itself in the forests and bush is one of the most serious aspects of the problem, as it affects us at present. In the States of Maine and New Hampshire it is gradually spreading northwards, and in the north-eastern region of Maine has reached already the international boundary, the St. Croix river. It is of the greatest importance, therefore, that a most careful watch should be kept in the townships bordering the frontier and, should anything be found, it should be immediately reported to the Department, and any objects that may be suspected as nests of the Brown-tail Moth should be forwarded for identification. A full account of the life-history and methods of eradication of this insect have already been given in the reports of the Division for 1906 and 1909, and, as a special bulletin is in preparation, it is not intended to consider at further length what is at present the most serious insect pest with which we have to contend.

A SYSTEM OF SPRAYING FOR INSECTS ATTACKING APPLE.

Reference will be made later to the species of insects which have proved injurious to fruit and fruit trees in Canada during the past year but, before considering these, it has been thought advisable to explain how a uniform system of spraying will serve to control a number of these insects which are injurious to the foliage and fruit. Immediately the buds have opened, the half-grown caterpillars of the Eye-spotted

* The Destructive Insect and Pest Act was passed shortly after the end of the fiscal year and the Regulations were ordered in May.

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Bud-moth, and, if they are present, the larvæ emerging from the winter nests of the Brown-tail Moth, and sometimes the hibernated adults of the Plum Curculio, all begin to feed on the young and tender foliage and in a few days they are assisted by the numerous newly-hatched Tent Caterpillars. All these insects could be controlled to a very great extent by an *early spraying* when the leaves are unfolding. The importance of this spraying cannot be too strongly urged. Later, when the blossoms are falling and the young fruit is forming, the Codling Moth caterpillar makes its appearance; a second spraying with an arsenical spray is necessary for this, especially as the largest proportion of the eggs of the Codling Moth are deposited on the foliage upon which the larvæ feed for a short time before making their way to the still open calyx of the young apple. To control this insect, and such others as the Canker-worms and Tent Caterpillars which are beginning to feed about this time, a *second arsenical spraying* should be given and this application should be most thorough, covering the upper and lower sides of the leaves and taking care to fill the calyces of the newly formed fruit with the solution. A *third application* of the spray should be made a fortnight later. This is essential, as, in many instances, the eggs of the Codling Moth and other caterpillars are late in hatching, or the hatching extends over a considerable period. Also, in certain cases, the Plum Curculio is a pest about this time and injures the young apples. Where a second or partial second, brood of the Codling Moth occurs, it will be necessary to make a fourth application to control the progeny of those insects of the first brood that escaped the effect of the previous sprayings. This application should be made from six to eight weeks after the falling of the blossoms.

Experiments have been carried on in America and in Europe for many years with a view to finding the best arsenical poison to use for these leaf-eating beetles and caterpillars and the results on the whole furnish strong evidence as to the superiority of lead arsenate over other arsenical compounds. This superiority is due to the following properties of lead arsenate.

1. It may be applied to tender foliage and does not scorch or burn it.
2. It is in the form of a finely divided precipitate and, in consequence, it is unnecessary to constantly agitate the spray fluid to ensure the even distribution and constant strength of the arsenical.
3. It is more adhesive to the foliage than Paris green, remaining on the trees longer, and, being white in colour, it is possible to see that the trees are thoroughly sprayed. In all these applications it should be mixed with the Bordeaux mixture or lime-sulphur, whichever of these are used to control the fungal diseases and should be mixed in the proportion of two to three pounds of lead arsenate to a barrel (40 imperial gallons) of the Bordeaux mixture. If lime-sulphur is used, it will be found that the best results are obtained by using the self-boiled lime-sulphur and adding the lead arsenate in the same proportion as above. Great care should be taken in the preparation of the Bordeaux mixture or its alternative the lime-sulphur mixture, as the burning of foliage and injury to the young fruit is, in the majority of cases, due to a mistake in making the mixture. The methods for making these insecticides are given in detail in the report of the Dominion Botanist for the present year.

INSECTS INJURIOUS TO FRUIT AND FRUIT TREES.

THE CODLING MOTH (*Carpocapsa pomonella* L.)

This still continues to be one of the most injurious insects with which fruit growers have to contend. It can be controlled, if growers are only willing to take the necessary steps: systematic spraying at the correct times and from year to year. Much trouble is caused, as I have pointed out previously, by the indifferent persons who do not spray and whose orchards act as reservoirs for this and other insect pests.

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Such indifference can only be overcome by education and example. Where there are two annual broods of the insect, it is necessary to band the trees with burlap, leaving the upper and lower edges of the burlap open. Even when one brood only is normally present, the value of the burlap is probably sufficient to warrant its use. Experiments have shown that if the trees are banded early in August and the burlap examined at weekly intervals, a considerable number of cocoons are obtained which would otherwise have escaped.

THE BUD-WORM OR EYE-SPOTTED BUD MOTH (*Tmetocera ocellana* Schiff.).

In Nova Scotia, the injuries due to this insect were of a serious character during the year although it did not appear to be so injurious in Ontario. There appears to be a marked periodicity in its abundance. The difficulty in dealing with the Bud-worm lies in the fact that it not infrequently has committed the most serious damage, that is, the destruction of the young leaves and immature blossom in the opening bud, before its presence is noticed. It is therefore necessary to be prepared, and to take the necessary steps *before* the injury is done by this insect as it is far more serious than a mere leaf-defoliator. It is one of the worst pests of the apple in that it destroys the young leaves and blossoms before these have had a start and is therefore capable of causing the entire destruction of the crop.

The young larva, measuring about one-eighth of an inch in length, passes the winter as a young caterpillar of a brown colour with a black head, sheltered in a small cocoon-like structure which is usually formed in the crotch between two twigs or between the twig and a bud. When the buds are opening, it emerges and begins to feed on the immature leaves and flowers and continues to feed until June or July when it spins a cocoon among the dead leaves on the twig, and the small grayish moth measuring about three-fifths of an inch across its wings emerges in July. It derives its name from the fact that it possesses an eye-like spot on each of the fore-wings. Flying by night, these moths deposit their inconspicuous eggs on the leaves. In about ten days these eggs hatch and the young larva feeds on the lower side of the leaf near the midrib. It feeds sparingly on the soft tissues of the leaf and its growth is extremely slow. For eight or ten weeks it continues to live in this position constructing for itself a filmy silk-like covering as it continues feeding. In September it ceases to feed and seeks a convenient niche in which to spin its winter case, and thus sheltered it remains until the buds open in the following spring. It will be seen, therefore, that there is a single annual brood only and the insect is remarkable for the comparatively great length of time which it spends as a small larva, hardly measuring one-eighth of an inch in length. The early spraying suggested previously is essential for the control of this serious enemy of the apple.

THE APPLE MAGGOT (*Rhagoletis (Trypeta) pomonella* Walsh).

In many orchards in Quebec this insect, or as it is sometimes called the 'Rail-road worm' on account of the peculiar winding tracks it makes in the pulp of the apple, is one of the most serious insects attacking the apple. The insect belongs to a large family of two-winged flies—the *Trypetidae*, which are popularly known as the Fruit-flies. They are small flies with banded or mottled wings and may be seen hovering round ripe and rotten fruit. In this country and in the United States *R. pomonella*, the Apple Maggot, is one of the worst apple insects in those districts in which it occurs; in Italy the Olive-fly (*Dacus oleæ* Rossi) is the most serious pest of the olive; the Mediterranean Fruit Fly (*Ceratitis capitata* Wiedemann) is very destructive to oranges in the regions round the Mediterranean. *Rhagoletis cerasi* Linn. is very destructive to cherries in Europe. In Queensland and New South Wales the Queensland Fruit Fly (*Dacus tryoni* Froggatt), has caused great loss wherever it occurs, as it attacks a large number of species of fruits such as the peach, nectar-

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ine, orange and banana, and occasionally the possibility of the introduction of this species into British Columbia has been the cause of some alarm.

The chief reason for the serious nature of these fruit flies is that the injury is done by the maggots or larva of the fly *inside* the fruit and in this connection they cannot be reached by insecticides. The female fly usually begins to deposit her eggs in July and continues to do so during the summer months. By means of her sharp ovipositor the egg is inserted beneath the skin of the apple so that the larva, on hatching, immediately begins to feed and as it feeds it makes brownish, discoloured burrows through the pulp until it is full grown, which is in about six weeks. A single apple may contain a number of maggots, the work of which causes the fruit to ripen prematurely and fall to the ground. The full-grown maggot then leaves the fruit and enters the soil to the depth of about two inches and changes into a brown puparium. In this state it passes the winter, emerging as a fly in the following June.

The most sure remedy, therefore, is to gather and destroy by burning the prematurely ripened and fallen fruit *as soon as it falls*. In this manner, the maggots are gathered before they leave the apple and can be destroyed. Wherever this plan has been adopted in orchards affected with the Apple Maggot, it has been found that there has been a considerable diminution in the number of apples affected, but it is necessary to collect the fallen fruit at once in order to obtain the best results. The turning of pigs into the orchard to destroy the fallen fruit has met with success, but many orchardists prefer to keep animals out of the orchard. An important fact is generally overlooked. It is extremely probable that the Apple Maggot (*R. pomonella*) is a native of North America and originally fed on the wild crabs, haws and certain other *Crataegi*, upon which it still feeds. If such trees exist, therefore, in the neighbourhood of orchards infested with Apple Maggot they should be cut down; otherwise they will serve as a breeding ground, furnishing a constant supply of the insects and all attempts to destroy them in the orchard will be frustrated.

Recently, some interesting experiments have been carried on with a view to destroying the female fruit flies before they lay their eggs. Their love for sweet substances is well known, and this fact has been put to practical use by spraying the foliage of the fruit trees in places with a sweetened arsenical, or hanging small supplies of the sweetened arsenical or poisoned bait in various places among the fruit trees. Such methods have been followed with success by Prof. Antonio Berlese in Italy against the Olive Fruit-fly (*D. oleæ*) and by Mr. Mally against the Fruit fly (*Ceratitis capitata*) in South Africa. The latter used a poisoned bait of the following composition: Sugar, 3 lbs., arsenate of lead, 4 ozs, and 5 gallons of water. It was applied to the trees by means of an ordinary brass garden syringe, using about a pint to a pint and a half to each tree (of about 10 years old). The object is not to thoroughly spray the trees but to throw the solution in fairly large drops on to each tree when the flies first appear and before they lay their eggs. They are attracted to the poisoned bait and die as a result of feeding upon it. It should be applied at least every ten days. It is hoped to carry out some experiments in Canada with a view to testing the efficacy of the Mally formula and Prof. Berlese's formula which differs slightly, but the former is described here in case certain fruit growers should wish to test it. The possible injury to bees has been suggested, but in the trials in South Africa careful attention was paid to this question and it was found that honey bees did not pay any attention to the solution. As the different broods of the Apple Maggot extend over the whole of the summer, it frequently happens that the fruit that is gathered contains growing maggots. Such fruit is packed and the maggots, having finished their growth, leave the apples and pupate in the barrels or cases. In this manner, the insect is often distributed to regions not previously infested. Care should be taken, therefore, to carefully collect and burn all the refuse from fruit stored in rooms or barrels before the flies emerge, which may be as early as May when the pupae are kept indoors. It has been found that by keeping the infested fruit for

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a number of weeks in cold storage, the maggots are killed by the prolonged low temperature.

THE PLUM CURCULIO (*Conotrachelus nenuphar* Herbst).

In addition to being one of the worst pests attacking plums, this weevil is responsible for serious damage to apples. In the province of Quebec, its attentions are chiefly confined to the apple, and in Ontario considerable injury is frequently caused in June and July and also from August to October by the weevils puncturing the fruit and the formation of wounds and small decayed spots caused by the rotting of the apple in the neighbourhood of the puncture. It was reported from Hamilton, Prince Edward Island, as injuring cherries. The emergence in the spring of the adult weevil from its hibernation varies considerably, and may extend from the time the leaves are unfolding until several weeks later. The system of spraying recommended will be of great benefit in the destruction of the weevils as they feed for a short time on the young foliage and fruit before laying their eggs in the fruit. In this manner, the proportion of infested fruit will be greatly reduced. In a number of experiments carried out by Mr. F. L. Washburn, State Entomologist of Minnesota, he obtained 53 per cent of marketable fruit when the trees were not sprayed, and 77 per cent of marketable fruit (in the following year, 1908, he obtained 86.4 per cent) when three applications similar to those which have been suggested were made. As the larvæ are in the apples when they fall to the ground, the destruction of the windfalls, as in the case of the Apple Maggot, will reduce the numbers of the insect very considerably. A method which is very frequently employed for the destruction of the adult weevils is that of jarring the trees and causing the beetles, which feign death and drop when disturbed, to fall into a sheet spread beneath the tree; the beetles so collected are then emptied into a can of water, the top of which is covered with kerosene.

CANKERWORMS.

Two of these insects, the Spring Cankerworm (*Paleacrita vernata* Peck.), and the Fall Cankerworm (*Anisopteryx pometaria* Harris) have been injurious. The loss caused by the Fall Cankerworm has been very great in certain regions, especially in Nova Scotia, where orchards were completely stripped and were very noticeable on account of their brown appearance. The latter species can be distinguished from the former by the fact that it possesses three pairs of clasping legs on the hinder region of the body, whereas the Spring Cankerworm possesses two pairs only. The female moths are inconspicuous, wingless insects, and emerge from October to May, during the time of the year when the leaves are off the trees. They crawl up the trunk and deposit their eggs in regular masses on the twigs. This habit and the wingless character of the female provide an important means of control. Each tree should be banded about four feet above the ground or below the lower branches with a three or four-inch band of 'Tanglefoot' (a good substitute can be made by dissolving resin by heating, and mixing it with an equal part of boiling castor oil). This is applied before the beginning of October, and in the case of the Fall Cankerworm care must be taken to keep the surface of the tanglefoot fresh by passing a coarse wooden comb round it and also to preserve its continuity around the tree. When the female moths emerge they crawl up the trunk and are prevented from reaching the branches by the tanglefoot bands; unless this is kept fresh, however, it will be bridged over by their dead bodies and its object will not be accomplished. This method of destroying the females and preventing them from laying eggs, which is the most essential means of combatting the insect should be supplemented by spraying with arsenate of lead, using not less than three pounds of the arsenical to 40 imperial gallons of water, (or Bordeaux Mixture, if the combined spray is used).

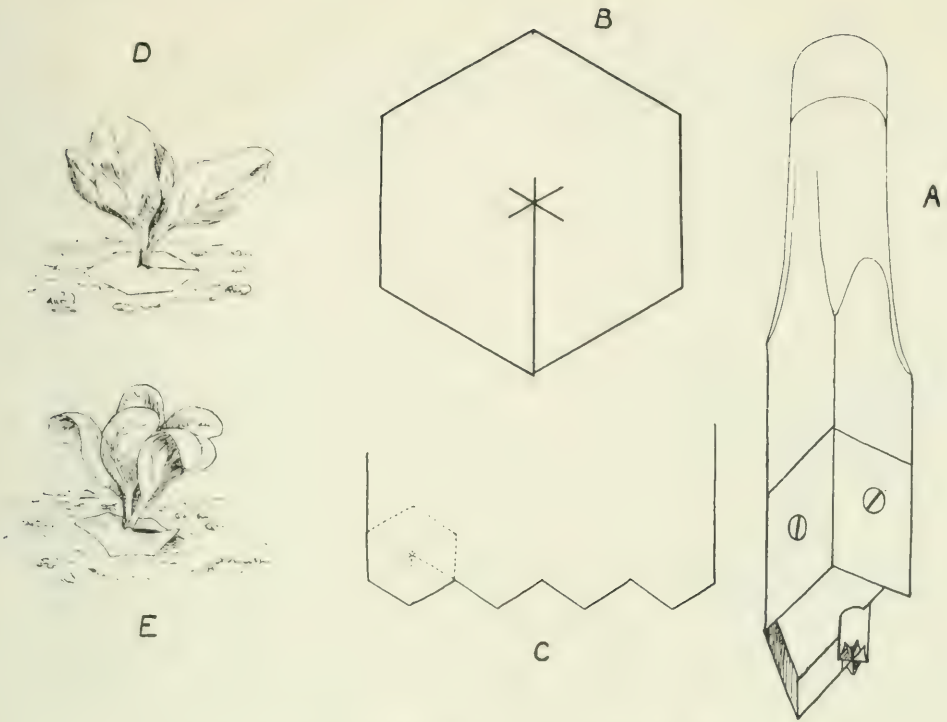


FIG. 1.—Goff's Tarred paper device for the Cabbage Root Maggot.

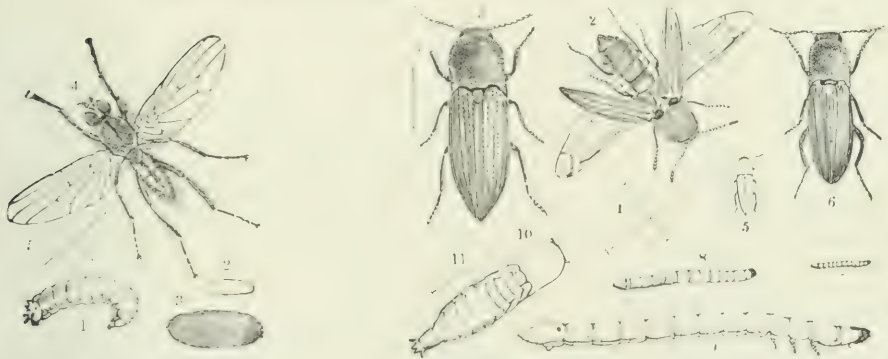


FIG. 2.—The Cabbage Maggot :
1, maggot ; 2, 3, pupa case ; 4, fly—
1, 3 and 4 enlarged.

FIG. 3.—Wireworms (7, 8, 9) ; pupa (10)—enlarged ;
click-beetles (5—natural size ; 2, 3, 6—enlarged).
(Curtis.)

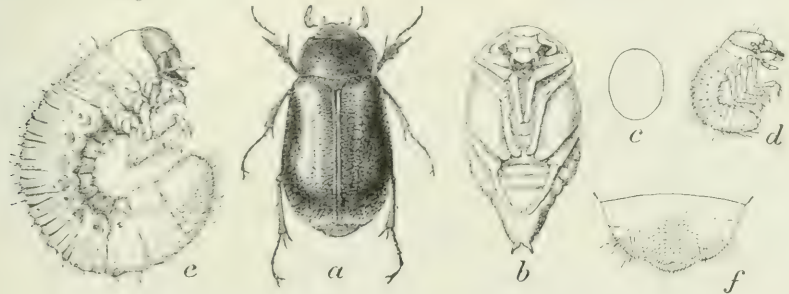
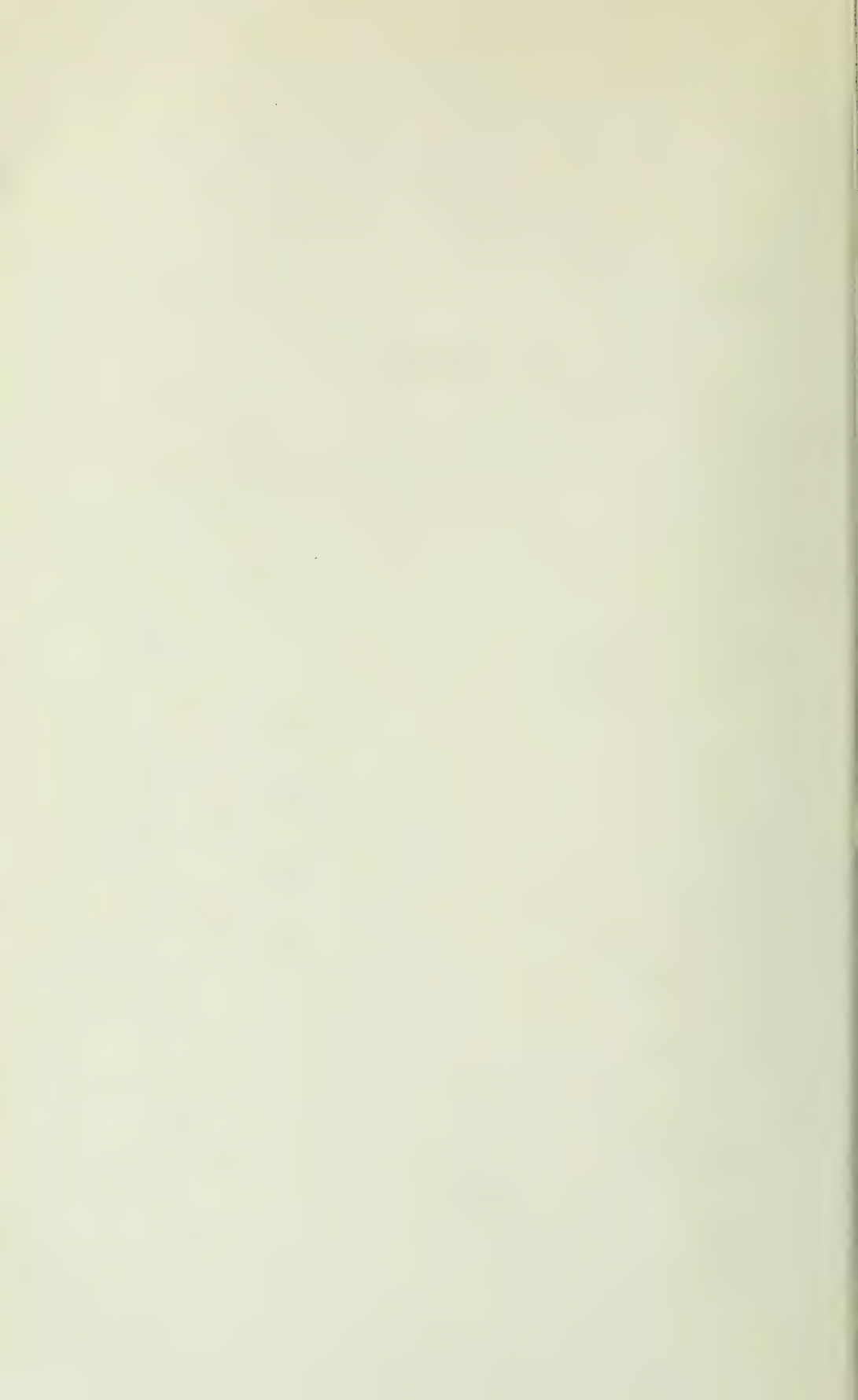


FIG. 4.—May Beetle : a, beetle ; b, pupa ; c, larva (White Grub)—slightly enlarged.
(Chittenden, Bull. 19, n.s., Div. of Ent., U.S. Dept. of Agr.)



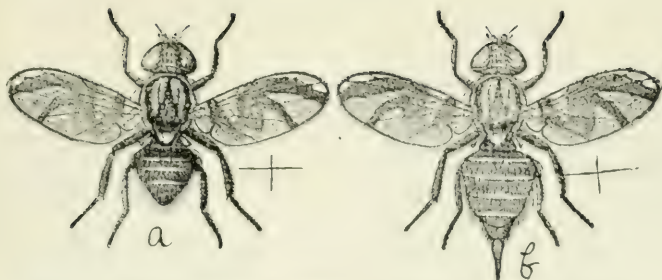


FIG. 5.—Flies of the Apple Maggot: *a*, male; *b*, female—enlarged.



FIG. 6.—Apple infested by Apple Maggot.

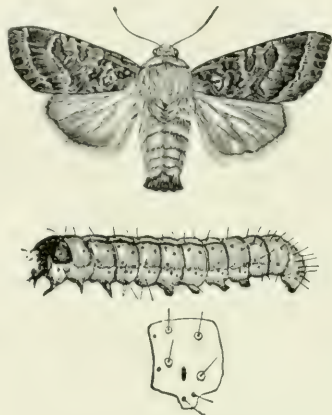


FIG. 7.—The Glassy Cutworm: moth and caterpillar.

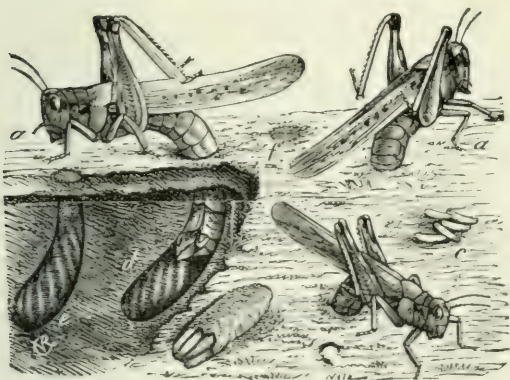


FIG. 8.—Locusts laying eggs.
(Riley.)



FIG. 9.—The Destructive Pea Aphid: winged viviparous female—enlarged 6 times.

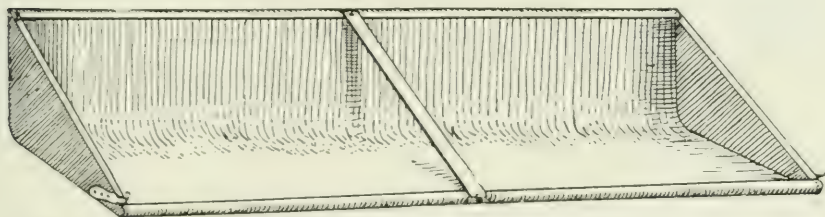
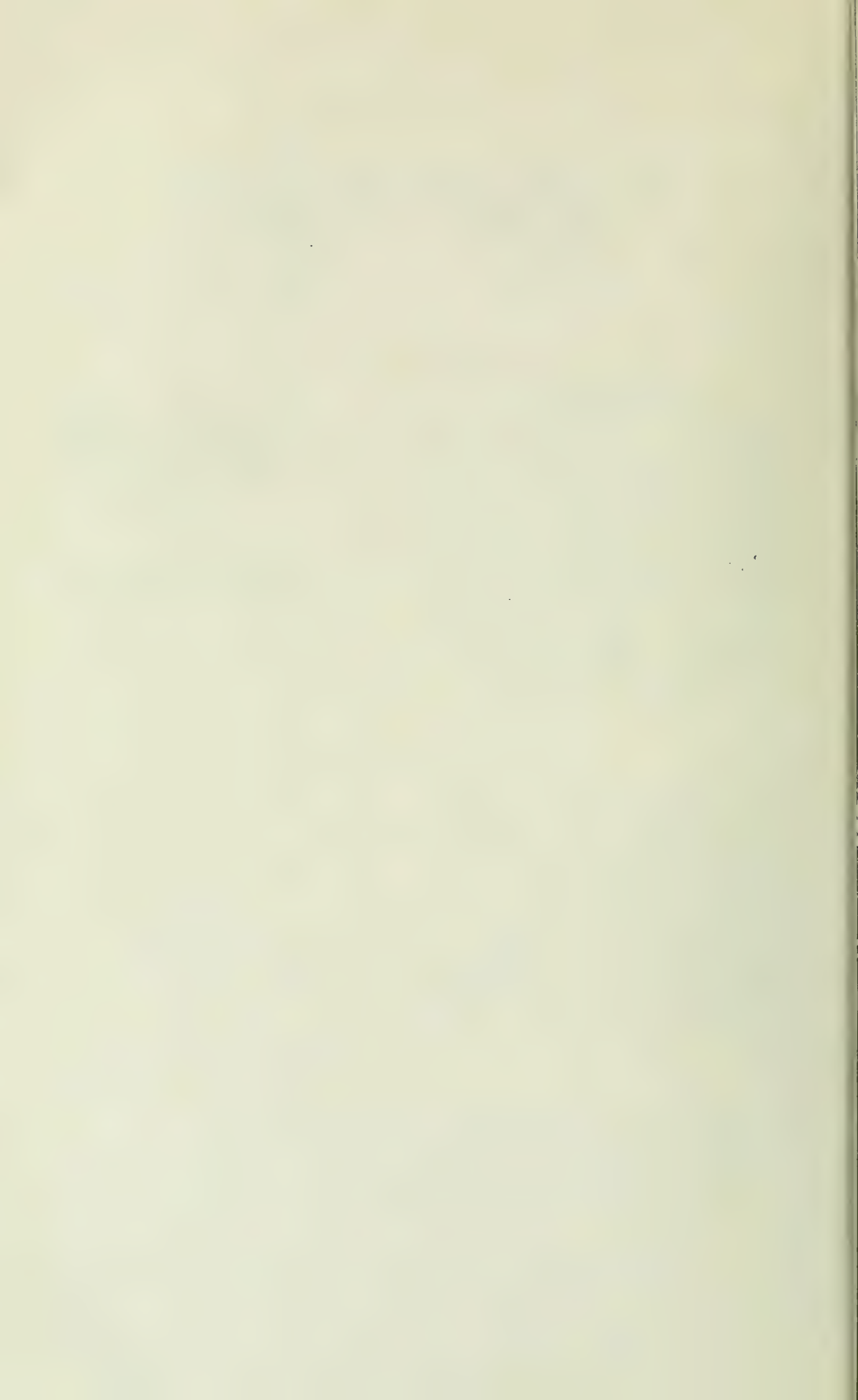


FIG. 10.—A Hopperdozer.



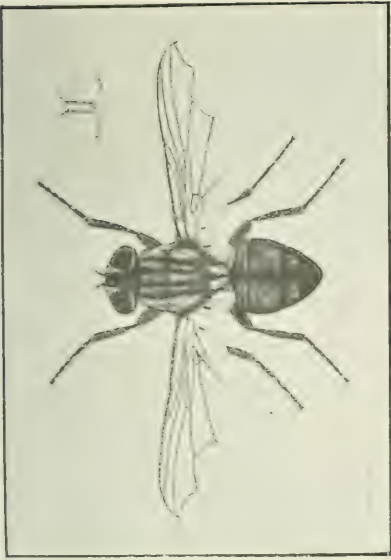


FIG. 11.—The House Fly.



FIG. 12.—The Stable Fly.



FIG. 13.—The Lesser House Fly.

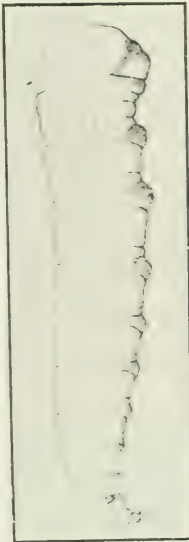


FIG. 14.—Maggot of the House Fly.

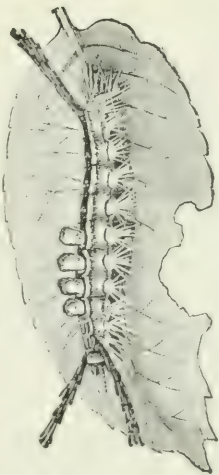
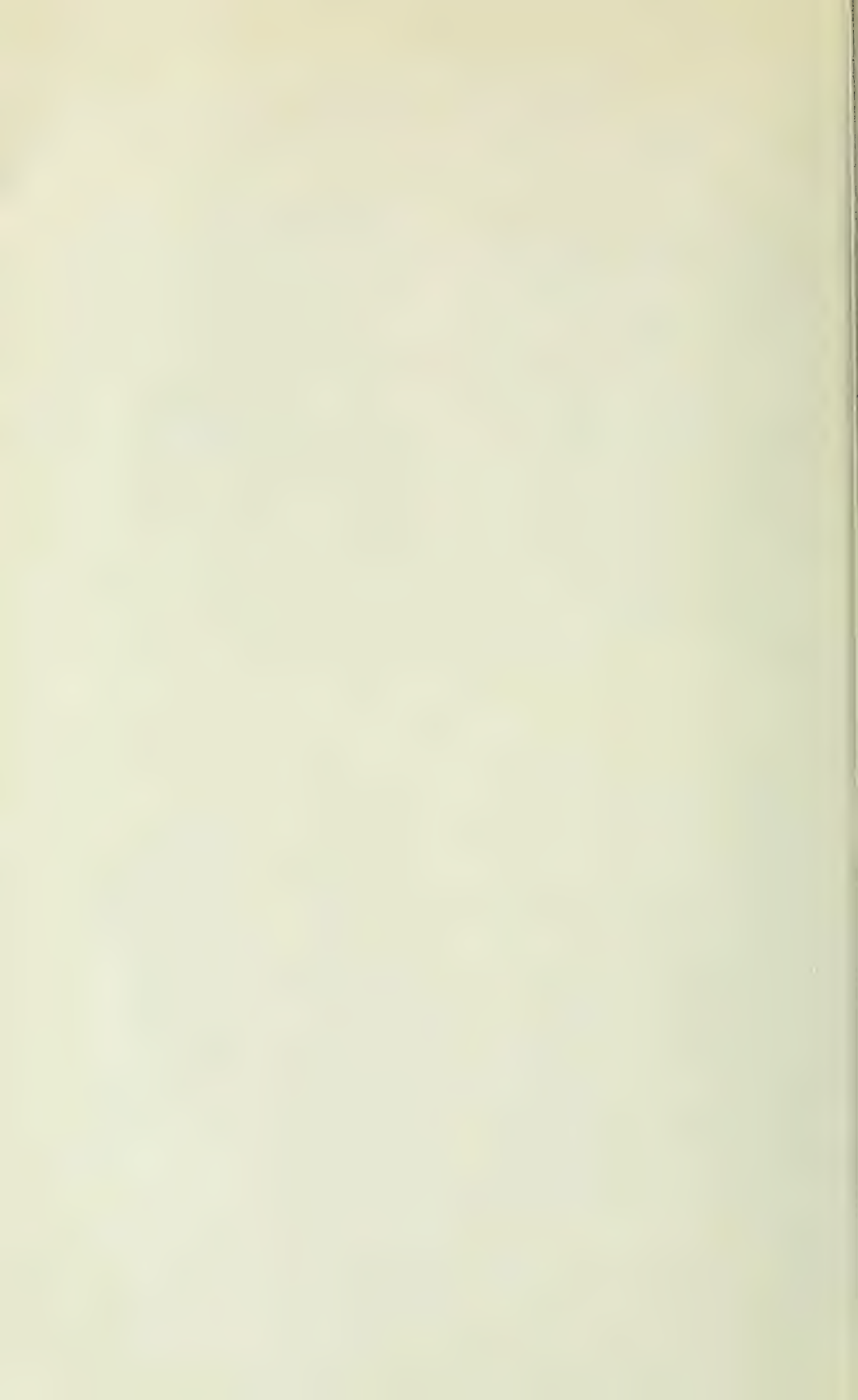


FIG. 15.—Caterpillar of White-marked Tussock Moth.



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OTHER INSECT PESTS OF FRUIT.

In addition to the above insects which proved to be the most injurious during the year, outbreaks of certain other species have been reported and investigated, among which the following are worthy of record.

TENT CATERPILLARS.—Several species, the chief of which are *Malacosma americana* Harris, and the Forest Tent Caterpillar (*M. disstria* Hbn.), have been responsible for great defoliation of orchard and forest trees in the eastern provinces and in British Columbia. The eggs of the two species can be distinguished by the fact that the egg-masses, which in both cases are deposited in the form of a band round one of the smaller twigs, in the case of *M. americana* are rounded at the ends, whereas those of *M. disstria* are cut off somewhat squarely at the ends.

THE TUSOCK MOTHS.—The White-marked Tussock Moth (*Heemerocampa leucostigan* S. & A.) was reported from Prince Edward Island, Nova Scotia and Ontario. In the latter province, it also defoliated the shade trees in certain of the larger cities. The Rusty Tussock Moth (*Notolophus antiqua* L.) was abundant in Nova Scotia and in Prince Edward Island. Both these insects appear to be subject to parasitic enemies, and their serious injuries are usually of a sporadic nature.

THE RED-HUMPED APPLE TREE CATERPILLAR (*Schizura concinna* S. & A.) was reported to be abundant in the different provinces of eastern Canada.

THE CHERRY AND PEAR SLUG (*Eriocampa cerasi* Peck.) was very common in fruit-growing regions throughout the Dominion. Most of the injury appeared to be caused by the second generation, and its results were therefore not so serious as they might have been. The Cherry-leaf Beetle (*Galerucella cavicollis* Lec.) was reported from Nova Scotia in July, and, in one instance, the injuries were so great that the crop was useless. It is a pest of the wild cherry and occasionally attacks cultivated cherries. The Currant Maggot (*Epochra canadensis* Loew) was reported from Lebreton, Sask., and the Snowy-tree Cricket (*Ecanthus niveus* Serv.) injured raspberry canes in Ontario.

INSECTS INJURIOUS TO FIELD CROPS AND CEREALS.

Although one of our correspondents writing from Millwood, Man., commented on the variety of new insect pests occurring during the year, which is only to be expected as more land is annually brought under cultivation, there have been no very serious outbreaks of insects injurious to cereals reported to the Division. With the exception of White Grubs and Wireworms, which have already been discussed, the insect most seriously injurious to field crops appears to have been the Hop-flea Beetle (*Psylliodes punctulata* Melsh.). In many localities in the provinces of Ontario and Quebec, grasshoppers have been the cause of considerable loss to farmers and it is unfortunate that so few, if any, of them attempt any eradication measures but allow these insects to increase by accumulation.

THE HESSIAN FLY (*Mayetiola* (*Cecidomyia*) *destructa* Say) was reported from Ontario and also from Saskatchewan, and the Greater Wheat-stem Maggot (*Meromyza americana* Fitch) also occurred in a number of localities in Ontario. At Claresholm, Alta., the Western Wheat-stem Sawfly (*Cephus occidentalis* Riley & Marlatt), was so injurious to wheat that in certain places it was difficult to harvest it, owing to the wheat being laid flat by the breaking of the stems.

The treatment of insects injurious to cereals is by cultural methods devised in accordance with the life-history of the species in question. The most important of these methods are clean farming and the prompt destruction of volunteer crops.

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In the case of the Hessian Fly and the Wheat Midge (*Diplosis tritici* Kirby) the screenings and chaff should be burnt.

LOCUSTS.—In certain regions of Ontario and Quebec the Lesser Migratory Locust (*Melanoplus atlantis* Riley) occurred in large numbers, destroying growing oats and turnips: in a number of cases turnips had been sown twice and both crops were destroyed. Mr. Gibson found the species in enormous numbers in the Baskatong region of Quebec. The same species and also the Red-legged Locust (*M. femur-rubrum* DeG.) were injurious in certain sections of Manitoba, where the Criddle mixture has proved a very effective and at the same time a simple remedy. It is made by well mixing 60 lbs. of horse droppings, 1 lb. of Paris green and two lbs. of salt in a barrel. This mixture is then carted to the edge of the field infested with the locusts which are extremely fond of horse droppings and are killed by feeding upon this poisoned bait. When the young locusts or 'hoppers' are common, they can be destroyed in large numbers by the use of a 'hopper-dozer' which consists of a long shallow and narrow tray containing water covered with coal-oil. (See illustration.) This is dragged over the infested ground and the 'hoppers' leap up on its approach and drop into the water and are killed. Attention should also be paid to the cultivation of the land that has been infested. It is found that the eggs are generally deposited on land which has been under crop, especially if it has been left as a summer-fallow. Wherever locusts have been abundant, all stubbles should be ploughed down as soon as possible and, if the summer-fallowing is adopted, it should be started early. The habit of the locusts of depositing their packets of eggs in cultivated land renders their control in this manner in a large measure possible.

THE HOP FLEA-BEETLE (*Psylliodes punctulata* Melsh).—In 1908 it was estimated that 80 per cent of the hop crop in British Columbia was destroyed by this insect and the problem, therefore, had assumed a serious character. It is not the same species as the English Hop-beetle which is *P. concinna*. On visiting the district in October, 1909, I was informed by Mr. Hulbert that the beetle had not been so serious during the year as in the previous four years. This decrease may be due to the active control measures that have been employed in the hop yards and also, to some extent, to predaceous and other enemies. The chief difficulties in controlling the insect are the rapid growth of the hops and the continued emergence of the beetle. Owing to the former circumstance, the value of spraying with arsenicals is greatly reduced by the continued production of new foliage upon which the beetles continue to feed, and the prolonged emergence of the insects provides a succession of the pests. The eggs, larvæ and pupæ occur beneath the soil at a depth of three to six inches, according to Mr. H. T. Quayle, who made observations on this insect. The larvæ feed on the roots of the hop and other plants and the adults have been found feeding upon nettle, potato, mangel, beet, turnip, dock, lamb's quarter, pigweed and red and white clover. It is of great importance to keep down wild solanaceous plants and weeds and to adopt such clean methods of cultivation as the burning of all refuse and old vines. Mr. Hulbert, (Chilliwack, B.C.), found the following measures of value in destroying the adult beetles: smearing the stems of the vines with tanglefoot to a height of about a foot from the ground, shaking the beetles off the vines on to tarred cloths or boards held down below on the ground and also dusting off the beetles with a feather brush on to tarred boards or cloths. Deep ploughing in the fall is also to be recommended.

THE POTATO FLEA-BEETLE (*Epitrix cucumeris* Harr.) was found causing injuries to the potato crop in Prince Edward Island and in certain sections of Ontario. The use of poisoned Bordeaux mixture would control this insect as in the case of the common Potato Beetle (*Leptinotarsa decemlineata* Say).

In Manitoba and the west, the Red Turnip Beetle (*Entomoscelis adonidis* Fab.) was more destructive than usual, especially to garden-grown turnips. Mr. Norman

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Criddle reports that he found the beetles at Aweme, Man., feeding first on the wall-flower (*Erysimum parviflorum* Nutt.) and the Worm-seed Mustard (*E. cheiranthoides* L.), later they attacked the turnips. The eggs usually hatch in the spring before the cultivated plants are available and the larvæ accordingly feed upon wild species of plants, usually belonging to the same natural order as the cultivated ones, in this case the Cruciferae (as also is the case in the Flea-beetles). This indicates the importance of *clean cultivation and the destruction of all weeds*, upon which I have previously insisted. When farmers and fruit growers realize that in many of these insect attacks, the intensity of the attack, and often the presence of the insect, is entirely due to the presence of weeds or of wild trees belonging to the same or allied natural orders as the cultivated plants that are attacked, they will be more unwilling to have weeds growing in and around their fields and wild plums and crab apples around the hop gardens and orchards. Clean cultivation is a factor as necessary in farming and fruit-growing to combat insect pests, as clean houses and sanitary conditions are in the prevention of human diseases.

BLISTER BEETLES.—These insects furnish an interesting example of a useful insect which at times becomes noxious. The larvæ of these beetles are useful, owing to the fact that they feed on the eggs of grasshoppers and other insects. The adult beetles, however, occasionally appear in swarms, and, by feeding on the foliage of cultivated plants, cause serious damage. They are elongate and narrow insects and, of the three species which commonly occur, two were reported as being seriously injurious. The Black Blister Beetle (*Epicauta pennsylvanica* DeG.) caused great destruction to the foliage of potatoes in the neighbourhood of Fort. William and Algoma, Ont., and in Quebec. It injured potatoes in Manitoba in July and also attacked Delphinium. The Grey Blister Beetle (*E. cinerea* Först) was reported from Cowansville, Que., as attacking horse beans, potatoes and vines. As the larvæ of these beetles are beneficial, the wholesale destruction of the adult beetles is not to be recommended, but when the beetles appear they should be driven off the crops by a line of boys or men walking through the crop with branches or switches, and it is usually found that when driven thus they do not return.

CUTWORMS.—From year to year these insects, which are the larvæ or caterpillars of Noctuid moths, are constantly reported as inflicting damage, varying in magnitude, to different field and garden crops. Such common species as the Glassy Cutworm (*Hadena devastatrix* Brace), the Red Backed Cutworm (*Paragrotis ochrogaster* Gn.) and the Variegated Cutworm (*Peridroma saucia* Hub.) are the more destructive and were sent in from different parts of the Dominion. The methods which are used in preventing cutworm injuries are: (1) the placing of small metal cylinders round the plants; (2) surrounding the bases of the plants with poisoned bran, prepared by mixing half a pound of Paris green with fifty pounds of slightly moistened bran, and to each gallon of water used in moistening the bran, half a pound of sugar is added; (3) when the cutworms are attacking a crop they can be destroyed by the use of poisoned bait in the following manner: a small patch of clover is well sprayed with an arsenical poison (1 pound of Paris green to 150 gallons of water, or 6 pounds of lead arsenate to 100 gallons of water), it is then cut and the poisoned vegetation is distributed in small heaps around the infested crop, a small board or shingle being placed on the top of each heap to conserve the moisture.

A large variety of insects attacking field crops, vegetables and roots, in addition to those that have already been mentioned, were reported to the Division. The Pea Aphis (*Nectarophora pisi* Kalt) was destructive in certain parts of Quebec and Ontario from July to September. It was found that the small hymenopterous parasite (*Megorismus fletcheri* Crawford), was responsible for the reduction in the numbers of this aphid; parasites emerged on September 15 from aphids collected on September

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2. The most satisfactory method which has been found of controlling this insect is that of brushing the aphids off the plants by means of switches and following this up with a cultivator; by these means the aphids are swept off the plants and their return rendered impossible. A special machine for this purpose has been manufactured. The Pea Weevil (*Bruchus pisorum* L.), which has been increasing in abundance during the past few years, was reported from Quebec and also from Ontario where it is more prevalent in the western counties. Farmers are beginning to realize that this insect can be controlled by the fumigation of the seed peas with carbon bisulphide, and it remains for them and other growers to co-operate and secure the fumigation of all infested peas. In such a manner, the weevil could be eradicated from any locality in which it now occurs and at little expense. In certain of the counties of New Brunswick and Nova Scotia the Carrot Rust-fly (*Psila rosæ* Fab.) was responsible for considerable injury to carrots, especially by the maggots of the later broods infesting the stored roots. When the insect occurs in the stored roots, it can be destroyed by fumigation with carbon bisulphide in air-tight receptacles, using 1 to 2 ounces of this chemical to 100 pounds of roots. Where they are attacking the growing carrots, it is even more difficult to apply remedies than in the case of root maggots. It is sometimes advisable to sow as late as possible and thus escape the egg-laying of the flies.

Aphides attacking turnips, cabbages and potatoes were as abundant as these previously described on trees, and probably for the same reasons.

INSECTS INJURIOUS TO FOREST AND SHADE TREES.

Of all injurious insects, these are the most abundant, but the attention that is paid to them is not in proportion to their abundance or importance. Nevertheless, as our forests become annually more valuable as national assets and the shade trees in our cities and towns increase in importance and value in like manner, it becomes more and more essential to conserve these possessions, the value of which is not always sufficiently realized. The formation of forest reserves and of national parks and the improvement of our cities, all these activities necessitate the devotion of greater care to the control of forest and shade tree insects and to the discovery of means to prevent the annual destruction of millions of trees, which goes on at present.

THE LARCH SAWFLY.—The most serious forest insect at present is the Larch Sawfly (*Nematus erichsonii* Hartig.) which is destroying, and has already caused the death of the greater portion of the larches or tamaracks throughout eastern Canada from Nova Scotia almost to Winnipeg. It is repeating the history of the outbreak in 1882-85, when it destroyed practically all the mature larches through this region and the only means of control for a forest insect occurring on so large a scale are its starvation by the killing of its food plant, which repeated annual defoliation is bringing about, and the increase of its natural parasites, which is indicated by observations that we are now making. Fortunately, as timber, the tamarack is not so valuable in Canada as yet, but the gradual exhaustion of the timber supply will increase the value of this tree which is so well adapted for growing in rough and muskeg country, and its collective value as a forest tree should not be lost sight of. The Sawfly was not found west of the Rocky Mountains where the western species of larch is fairly common. It is interesting to note its marked preference for the European larch. A study of this insect and its insect and fungal parasites of both this continent and in Europe is being made.

THE SPRUCE BUD-WORM.—In July, the Hon. W. C. Edwards reported that an insect was causing much damage to spruce and balsam in the Upper Gatineau region about 100 miles north of Ottawa. Mr. Gibson visited the infested region and, on examination, found that the injuries were caused by a lepidop-

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terous larva known as the Spruce Bud-worm (*Tortrix fumiferana* Clemens). He reported that thousands of empty chrysalids were found on the trees where the caterpillars had been feeding. The enormous numbers of the brownish-red chrysalids, together with the larval excrement and loose, partly-eaten and discoloured foliage gave the conspicuous reddish appearance to the tops of the trees. Beyond the loss of the foliage of the upper portions of the trees, they were not seriously injured. The foliage for about four or five feet from the tops of the trees was almost wholly destroyed. The moths were seen at the time of the visit on July 29 and also on the Central Experimental Farm. The infestation was of a wide nature, occurring not only in Quebec but in the maritime provinces. It was also reported on July 14 from British Columbia by Mr. J. R. Anderson, for whose reports on different insects from time to time we are greatly indebted, as they are of great value to us. In Victoria, B.C., the moths occurred in enormous numbers and the same abundance was reported by Mr. Hanham, of Duncans, B.C. This species was recorded by Dr. Fletcher in his report as Entomologist for 1885, in which year it was reported from Quebec and from New Brunswick and he believed, as I also believe from evidence recently collected, that the damage to spruce in eastern Canada is not entirely due to this insect. In many instances it is no doubt the work of the Bark-boring Beetle (*Dendroctonus piceaparda* Hopk.). The seriousness of the attacks of the Spruce Bud-worm is due chiefly to the fact that it attacks the buds which, in such a slow-growing tree, affects the growth considerably and repeated attacks will kill the tree. When visiting Vancouver Island in October, I learnt that the infestation was increasing and found that the insect was attacking mainly the Douglas Fir (*Pseudotsuga mucronata* Raf.) Sudw. In some ornamental grounds, it was also found that it had been feeding on larch, silver fir, Norway spruce, deodar and African cedar. Dr. Fletcher also found it attacking spruce trees in Manitoba in 1907.

The eggs are laid on the leaves towards the end of July and the young larvæ are pale green. The winter is passed in the larval stage and, when the larvæ continue to feed in the following year, they construct for themselves shelters by binding together the loose leaves or needles. When full grown, which is about the end of June, they are of a reddish brown colour and they pupate in the loosely made shelters, emerging from the pupæ about the middle of July. It was found in British Columbia that the spread of the moth had been in the direction of the prevailing winds, as the moths are very easily carried by the wind.

BARK BEETLES.—Several species of bark beetles were reported as causing serious damage to coniferous trees, and it is evident that the destruction of much of the timber in Canada which is attributed to fire and other causes is in no small part due to the work of bark-boring beetles, many species of which attack the strong and healthy trees and by boring through the growth layer retard and prevent the growth of the tree, which, weakened in vitality, is then liable to the attacks of various other species; when finally killed, the timber is attacked by the timber-boring beetles. Trees weakened by fire are susceptible to the attacks of a large number of species of these beetles which are not infrequently responsible for the final destruction of large areas of fire-swept forest. It is of the greatest importance to recognize the attacks of forest pests in the earliest stages when there is often hope of control. Later, when the infestation has reached some magnitude, such hope must be abandoned as a rule.

THE EASTERN SPRUCE BEETLE (*Dendroctonus piceaparda* Hopk.).—Portions of spruce trees, killed and dying, were received from Cape Breton, Nova Scotia, and they proved to be seriously infested with this species, which was also reported from Digby county, Nova Scotia, and New Brunswick. Dr. Fletcher recorded this species, under the specific name of *rufipennis*, in his report for 1887, as injurious in the Eastern Townships of Quebec. The small reddish brown to black beetles usually emerge about June and boring into the bark they excavate galleries along the sides of which the

eggs are deposited. On hatching, the larvæ feed on the soft lower layers of the bark and form galleries running from the central egg gallery. The early-hatched larvæ are fully grown about August and they change into pupæ and later into mature beetles which hibernate in the larval burrows until the spring. If the trees are barked during the hibernating season they may be felled later, or they may be felled at once, but felling is the only method to be employed in the control of this insect.

From Almonte, Ont., a bark beetle which appeared to be the Black Turpentine Beetle (*Dendroctonus tenebrans* Oliv.) was reported. In this locality many of the balsam and cedar and some pine and spruce trees were dead and other pines were dying. Beetles were taken from tree roots of 15 to 18 inches in diameter and they were very numerous in the underground portion of the tree. This appears to be somewhat northerly for the distribution of this insect. A species of bark boring beetle injuring pines near Lake Joseph, Muskoka, was reported, but no specimens were received.

THE BRONZE BIRCH BORER (*Agrilus anxius* Gory).—A large number of the cut-leaved birches on the grounds of the Central Experimental Farm, Ottawa, and in the neighbourhood, were found to be dying off at the tops, and on examination it was discovered that the death of the branches was due to the larvæ of this most destructive insect. The 'flat-headed' boring larvæ were found boring their way in winding and zig-zag burrows through the sap wood, and in some cases the borings extended to the centre of the branch. Branches and twigs of all thicknesses were attacked. This species is under observation, but the available evidence and that of other investigators, notably Slingerland, indicates that once a tree is attacked there is no possible method of eradicating or controlling the insect and the immediate felling and burning of such trees to prevent the dissemination of the insect is necessary.

THE RIBBED RHAGIUM (*Rhagium lineatum* Oliv.).—Adults of this species were found in their characteristic pupal cells on March 3, together with the white broad-headed larvæ under the bark of spruce trees killed in Nova Scotia by *Dendroctonus piceaperda* Hopk. Packard and Felt record this species as being common on pine, for which reason it is called the Ribbed Pine-borer by the latter. Cavities are formed by its boring underneath the bark, and these are usually found filled with frass. These excavations loosen the bark and cause it to fall away. As mature beetles and larvæ occurred together in March, this species evidently passes the winter in Canada in both these stages.

THE BIRCH LEAF-MINING SAWFLY (*Phlebotrophia mathesoni* MacGillivray).—This insect, for which the above common name is proposed to distinguish it from the leaf-mining Tineid caterpillars, is of interest scientifically as it is a species that has been present in Nova Scotia for about five years and was not described until about October, 1909, when Dr. MacGillivray described it in the *Canadian Entomologist* of that month (pp. 345 and 346) creating a new genus for it. Its attacks during the year have been very severe in Nova Scotia, the birch leaves appearing brown and withered as if the trees had been killed; in consequence, some alarm was created. The larva is a small worm which bores and mines inside the tissue of the leaf and by destroying all the green living tissue of the leaf produces the brown and dead appearance. About the time the leaves are ready to fall, the larva, according to Prof. H. W. Smith, 'spins a circular nest in the mine it has made,' and in this it passes the winter, and, as is the case with a number of the sawflies, it pupates in the spring, emerging shortly afterwards as a small black sawfly. It is not unlikely that the injuries of this leaf-mining sawfly have been mistaken for those of the Birch Skeletonizer (*Bucculatrix canadensisella* Chambers), which is also common in the provinces of New Brunswick and Nova Scotia and was reported during the year from Kings and Digby counties, N.S. The White-marked Tussock Moth (*Heemerocampa leucostigma* S. &

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A.) was again injurious to shade trees in certain of the cities, notably Toronto and Hamilton. This species can be controlled by careful and systematic spraying with lead arsenate in the summer and by the destruction by means of creosote or the removal of the egg masses which are readily found in the winter. The Green-striped Maple Worm (*Anisota rubicunda* Fabr.) was reported from Bryer, Que., where it was defoliating sugar maples. The attack was more extensive during the past year than in 1908, and the injured trees were stated to yield much less sugar than the uninjured. This species also feeds on the soft maple. In the Eastern States it does not often occur in sufficiently large numbers to cause any serious damage, but is more injurious in the western states according to Felt. The Midrib Gall (*Cecidomyia negundinis* Gill.) was very abundant on the Manitoba maple in Manitoba and Saskatchewan. At Alexander, Man., a correspondent reported that a windbreak of about 2,000 young Manitoba maple trees were badly infested with this insect.

INSECTS INJURIOUS IN GARDEN AND GREENHOUSE.

In addition to certain of the insects, to which reference has already been made, a certain number of species injurious to plants in gardens and greenhouses, were received. Species of Thrips were injuring asters (Ontario) and roses (British Columbia). At Indian Head a species of *Aleyrodes* or 'White Fly' was destroying fuschias and these insects were also reported from Ontario and Quebec.

In Toronto, asters were destroyed by Aphides or plant lice which were found on their roots. These aphides appear to be placed in such situations by ants, which cultivate them to obtain their excretions of 'honey dew,' and ants are usually found in association with such root aphides. Where root aphides are found in association with ants, the treatment discovered by Prof. S. A. Forbes to prevent the appearance of the Corn-root Aphis (*Aphis maidi-radicis*, Forbes) may be of use and might be tried. A mixture is made of one gallon of wood alcohol and a pint of oil of lemon. If a few drops of this are placed in the soil near the roots of the plants the ants being repelled by the odour may not take the aphides to such roots as are protected. Diaspine, *Lecanium* and *Eulecanium* scales were sent in to the Division having been found upon greenhouse plants, and in all cases it was found that kerosene emulsion removed them readily.

HOUSEHOLD INSECTS.

THE HOUSE FLY (*Musca domestica* L.) (Fig. 11).—While this is the commonest household insect it is at the same time the most dangerous; not on account of its destruction of household effects, but owing to its habits which make it one of the most serious carriers of the germs of such diseases as typhoid fever, tuberculosis, infantile diarrhoea, &c., wherever flies occur in large numbers. No fly is free from germs, but all carry about the spores of moulds and bacteria and this is due to their habit of frequenting decaying substances and excrementous products for the purpose of depositing their eggs. Each female fly lays from 120-150 eggs at a time and one fly may lay six or more such batches of eggs during a single season. These eggs are deposited on any kind of decaying vegetable matter, such as kitchen refuse, &c., or on excrement. The chief substance in which flies are bred is horse manure, and wherever there are exposed heaps of horse manure flies will be present in very large numbers. From the small sausage-shaped white eggs, the maggot emerges and in a few days, if the weather is warm, it becomes full grown (Fig. 14) and changes into a brown puparium from which the fly emerges. The whole development may be complete in 9 or 10 days, or even less in very hot weather, and these flies which emerge are able to begin to lay in about a fortnight, so that the production of enormous numbers of flies is readily understood.

Owing to their serious and important relation to health, it is of the greatest importance to prevent flies from breeding, and this can be accomplished best by several means. No manure heaps should be left exposed within half a mile of dwelling houses for more than seven days. They should be removed within that time, and if possible the manure should be spread on the ground. This periodic removal applies especially to manure heaps in towns. Garbage tins in which flies frequently breed should be kept constantly covered and emptied at least once a week, and all such waste vegetable matter should be burnt. Great care and attention should be paid to the keeping in order of privies; soil or ashes should always be used, as such places, if not kept perfectly sanitary and all excrement covered, will serve, not only as breeding places, but also as possible sources of infection of disease. Where sanitary conditions and cleanliness prevail house flies will not be abundant, but where unsanitary conditions, exposed manure heaps, open garbage tins and heaps of decaying substances are found, house flies will abound in their myriads. To the farmer, care with regard to this insect is especially important, owing to danger of their infecting milk. In and about cow-sheds, where flies are common, the milk in pails should be screened with muslin as such flies are heavily infected with bacteria.

THE STABLE FLY (*Stomoxys calcitrans* L.) Fig. 12.—This species is common in Canada, especially in the fall. It normally occurs out of doors or in cowsheds and stables, but sometimes enters houses, and as it is a biting or blood-sucking species, it not infrequently bites man. Its general similarity of appearance to the common house fly is responsible for the idea that house flies bite, which is incorrect, as they are unable, by the structure of their probosces, even so much as to pierce the tenderest skins. It will be found that these so-called biting house flies are almost invariably *Stomoxys calcitrans*, which normally feeds on the blood of cattle. The larvæ or maggots have a similar appearance to the maggot of the house fly, and they breed chiefly in decaying and fermenting vegetable matter and excrement.

THE CROTON BUG OR COCKROACH (*Ectobia germanica* L.)—This has been reported from many localities as being a very serious pest in houses. It is light brown in colour and has two dark lines on the thorax; it measures about three-fourths of an inch in length. These insects are more than usually difficult to destroy, as they appear to be gifted with special intelligence and to be able to detect that a substance is poisoned. Houses should be kept clean, and all cracks that it is possible to fill should be filled. It has been found that a mixture of borax and sugar is effective as a poison. The painting of all the crevices and likely haunts with a dilute solution of formalin or formaldehyde (formaldehyde is a liquid that can be obtained from the drug store; to one part of this liquid, which should be 40 per cent solution, 10 parts of water are added to make a dilute solution) may be found effectual in eliminating them from a house. A very dilute solution of corrosive sublimate (which is poison) painted in the same manner may have the same effect. There are a number of roach-killing preparations on the market, some of which have a fatal effect on these insects.

ANTS.—These common household pests were reported frequently to the Division, and the small red ant. (*Monomorium pharaonis* Linn.) was, apparently, the worst offender. When they occur in large numbers their destruction is difficult. The first essential is to discover their nests, or the situation of such nests, and, having done so, a small quantity of carbon bisulphide should be injected. This solution (which is highly inflammable) volatilizes and the vapour is highly poisonous to insect life. The same treatment may be adopted in the case of ants occurring in large numbers in the garden; their nests should be found and the carbon bisulphide poured into holes made by means of a small stick. Coal oil or kerosene is also effective when poured into the nests of the ants.

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THE CARPET BEETLE (*Anthrenus scrophulariæ* L.)—This insect, sometimes known as the Buffalo Carpet Beetle, has been frequently reported as injuring carpets, large numbers of the larvæ or grubs being found round the edges of carpets; it also destroyed woollen goods and furs. The adult insect is a small stout beetle, (see illustration), measuring about one-eighth of an inch long and strikingly coloured, having the wing covers coloured black, yellowish-white and red, the red markings forming a line down the middle of the back from which three branches are given off on each side. The larva or grub measures one-eighth of an inch in length and its body is covered with groups of hairs. The beetles are common on flowers about June and not infrequently are carried into houses on flowers. In the house they deposit their eggs on the carpets and similar material, and the small hairy larvæ then feed on the same.

Carpets and materials badly infested with the beetle should be cleaned and afterwards treated with benzine (out of doors). If the attack is not great, they can be destroyed by laying a damp cloth over the infested portion and ironing with a hot iron; the hot steam that is generated is fatal to the grubs. The floors should be scrubbed with boiling water. When the carpets are laid, it has been found that the laying of tarred paper in strips about one or two feet wide beneath the carpet, around its edge, will prevent the beetles to some extent from laying their eggs on such carpets.

MITES AND OTHER PESTS.

A number of small creatures which are not insects, although they are classed very frequently with insects, are responsible for injuries to vegetation of different kinds. A large number of these belong to the Arachnids or Spider family, which are characterized by the possession of four pairs of legs instead of three pairs such as the typical insect possesses. This family includes all the mites, red spiders and ticks. In addition to these, the members of another family, of which the millipede is an example, often attack growing vegetables and other crops; cases of such were reported from Ontario and Nova Scotia.

The following were some of the more important of these pests which were reported to the Division:—

THE PEAR-LEAF BLISTER MITE (*Eriophyes pyri* Nalepa).—This mite, which appears to have been introduced into Canada on nursery stock from Europe, is becoming more serious annually. It was found throughout the Dominion, from Nova Scotia to British Columbia, being very bad in certain localities in the latter province. It will attack, not only the leaves of pear but also the young fruit, and the leaves of the apple. Early in the year, when the leaves are first attacked, they appear to be covered with bright red spots and swellings, which are most numerous near the centre of the leaf. Later these spots turn green, and finally brownish-black as the leaves become older and mature. These small spots or tubercles contain the mites, and are galls formed by the young mites entering the breathing pores or stomata of the leaves and feeding on the leaf tissue. The female measures less than one-hundredth of an inch in length. When they are full grown, they deposit their eggs in the galls, and the young mites, hatching out, leave the gall and seek new stomata, and in this manner form fresh galls. The mites pass the winter under the bud scales, especially those of the terminal buds, where they may be found in small colonies. The mites of this group are difficult to eradicate, and the best means that can be suggested is the thorough spraying of the trees, especially the buds, with lime-sulphur. This should be applied in the fall or as late as possible in the spring, shortly before the buds swell.

The mites belonging to this class, the Eriophyidae, are common on shade trees, and a number of species of *Eriophyes* were reported as causing injury. A species on ash and elm was stated to have caused the loss of several fine specimens of these trees in Quebec. In Ontario, maples were severely infested by another species.

THE APIARY.

Mr. D. D. Gray, who superintends the apiary, reports to me as follows on the wintering of the bees:—

WINTERING.

Thirty-eight colonies were put into the bee-cellar on November 18, 1909. In preparing them for the winter, air was given at both the top and bottom of the hive, each hive being raised from the bottom board about one inch. The cover was removed and replaced by two or three brown sacks. They wintered very well and no colonies were lost. They were taken out of the cellar and put on the summer stands on March 31.

The average weight of the colonies, when put into the cellar, was 46.27 pounds.

The average weight of the colonies, when put on the summer stands, was 36.65 pounds.

The average loss per colony during winter was 9.62 pounds.

The greatest loss for a single hive during the winter was 12 pounds, and the smallest loss 8 pounds. The colonies weighed from 40 to 57 pounds on entering the cellar, and 30 to 48 pounds when placed on the summer stands.

Two colonies, whose average weight was 48 pounds, were wintered in the same state as when taken off the stands; no attention being paid to ventilation. The average loss during the winter was 12 pounds. The bees did not appear to be contented, keeping down at the bottom of the hive, and many died during the winter. With the construction of a cellar in which the heat and ventilation can be regulated, together with the careful ventilation of the hives, the problem of wintering appears to be solved so far as is possible.

Mr. C. A. Burnside has carried on the practical work in the apiary, and to him and to Mr. Gray, whose careful attention to the wintering bees in the cellar is responsible for the excellent condition in which they were put on the summer stands, all credit is due.



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